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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—Wordsworth

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
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J. J. Thomson.

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SCIENTIFIC WORTHIES.

XL.—SIR J. J. THOMSON, O.M., F.R.S.

It is impossible to think of the rapid and profound evolution which occurred in the fundamental conceptions of natural philosophy during the final years of the past century without one figure looming large in the mental picture—that of the celebrated physicist of the University of Cambridge. In effect, the new and fruitful trend assumed by the science of physics in recent years has been in great part due to the happy intuition of Sir J. J. Thomson and to the experimental researches unwearyingly pursued by him and his students in the celebrated Cavendish Laboratory.

One circumstance is particularly striking in that movement—the unforeseen opening out of new and vast horizons to the physicist precisely at the moment when the electromagnetic theory of light had been victoriously acclaimed—a theory which not only gathered into one marvellously harmonious synthesis all the phenomena of the physical world, but at the same time satisfied that natural scientific instinct, which seeks for the greatest simplicity in its explanation of natural phenomena, by attributing to a single medium, the æther, the double office of transmitting electrical and magnetic forces as well as the waves of light.

In spite of this, physicists were not able long to rest upon their laurels; for certain classes of phenomena, which, perhaps, it was hoped would find an easy explanation, proved quite resistant to elucidation unless accessory hypotheses were devised.

If we go back in thought fifteen or twenty years, it is plainly visible that, after the definitive triumph of Maxwell's theory in the experimental field with the work of Hertz and his successors, the great unknown which we call electricity was still considered by all, in its real nature, more or less as an incompressible fluid which could displace itself in dielectrics, overcoming a certain elasticity, or flow in a conductor; whilst the principal electrostatic facts, metallic conduction and some other phenomena could be considered as intimately known. But the propagation of electricity in electrolytes, and more especially in gases, remained in part problematical.

To these two classes of phenomena was not attributed the importance they should have merited. But even then was perceived one most important specific character of electricity in the case of its propagation in electrolytes, namely, its apportionment into small parts, identical among themselves, and representing the charges corresponding with each valence of the electrolytic ions. The significance of this fact could not escape the mind of Maxwell; and it led him to consider those charges as *atoms* of electricity. Nor could it escape Helmholtz, who acutely pointed out that the existence of such charges must be considered possible, even apart from the ponderable matter with which they are ordinarily accompanied, even if it were only during the short time in which, having left the ion, they are about to enter the electrode to feed the current in the metallic portion of the circuit.

The existence of atoms of electricity, or of "electrons," according to the felicitous expression proposed by Stoney, was accepted without hesitation as a fundamental hypothesis in the theories constructed by Larmor, Lorentz and other mathematical physicists; and the former of these so far back as 1894 succeeded in outlining an electrical theory of matter. But, however seductive these theoretical investigations appeared, and in their comprehensiveness they represented a considerable advance on earlier theories, the real existence of electrons could not be accepted by physicists until a satisfactory experimental demonstration of their existence was forthcoming.

To succeed in such a demonstration undoubtedly appeared to everyone a sufficiently difficult matter; yet such has actually been achieved, thanks to the study of the kathode rays, that is, of certain peculiarities presented by electrical discharge and already known for some considerable time.

The phenomena of discharge have always attracted the attention of physicists, and innumerable studies have been made in this field. The peculiarities which they present, varied as they are almost indefinitely, and certain brilliant aspects which they possess, even though not always of the highest scientific interest, have rendered these studies so attractive, that it is difficult for anyone who has once pursued them to free himself from their seductiveness and pursue other researches. A rich material of facts thus went on accumulating, between which, however, in the majority of cases there was no intimate connecting link; this material was later to be coordinated by the electronic theory, which in turn gained many indirect confirmations from it. Finally, when, with the perfecting of technique, it became an easy matter to produce the greatest rarefaction of gases, the phenomena of the kathode rays assumed their due importance in the eyes of physicists; and all those who, by natural disposition or as a result of long experience in physical researches, possessed that fine intuition which in certain cases appears almost as a true divination, presaged that from the study of the kathode rays would accrue results of capital importance, capable of throwing light on the nature of electricity.

The very brilliant and ingenious experiments described by Crookes, and the theory of "radiant matter" proposed by him to explain them, gave a great impulse in the direction which has led to the actual views of to-day. It is true that that theory was combated, unfortunately, even by physicists of such high reputation as Hertz; but there were some, at least, who at once welcomed it with enthusiasm.

The present writer can boast that he was one of this small band, and that he drew from the theory the inspiration of numerous experiments, demonstrating the existence of electrified particles (ions) in gases under atmospheric pressure transmitting the discharge, and capable of producing with their movements regulated by electrical forces phenomena of "electrical shadows" similar to those produced by the kathode rays.

Meanwhile, shortly afterwards and independently of the explanation given of the kathode rays, various physicists sought to explain by the presence of mobile charges the conducting properties possessed by gases in certain circumstances, and it then appeared that they could not do better than apply to gases the mechanism imagined in the case of electrolytes. Schuster, Arrhenius, Elster, Geitel and others obtained noteworthy results in this field, bringing forward numerous proofs of the existence of ions in gases, and basing on the facts observed the explanation of divers phenomena.

It was not easy, however, to apply directly to gases the electrolytic theory. In the first place, an enormous difference exists between the two orders of phenomena as regards the difference of potential required to bring about a transmission of electricity, this difference being exceedingly small in the case of liquids and relatively great in the case of gases. Another formidable difficulty also presented itself in the fact that, whilst it is a most natural thing for atoms of different chemical nature to carry charges of different sign, so that, for example, there are negative ions of oxygen and positive ions of hydrogen, it was not easy to conceive that, in a given simple gas, there could exist ions of the same chemical nature but some charged positively and some negatively.

But this difficulty disappeared when, by the classical experiments of J. J. Thomson, it was rendered probable, and demonstrated, so far as this is humanly possible, that negative electrons or "corpuscles" exist and form an integral part of the structure of the atoms.

The suggestive fact having been observed by Perrin, and then by Thomson, of the effective transport of negative charges by the kathode rays, a fact which suggested the hypothesis that such rays consisted of the movement of particles expelled from the kathode, Thomson commenced in 1897 those famous experimental researches in which he succeeded in measuring, at the same time, the ratio e/m between charge and mass of the said particles and their velocity v. Having obtained for v a value clearly inferior to the velocity of light, and, above all, a value for e/m nearly two thousand times that corresponding with the ion of hydrogen, and, moreover, as it could be shown that the same identical particles always resulted on changing the substances dealt with in the experiments (electrodes, gases, &c.), it was revealed that those particles were neither atoms nor molecules, but the electrons themselves, contained in and expelled from the atoms. Others had previously employed the action of a magnetic field on the kathode rays to obtain the foregoing determinations, and Thomson himself had made a similar attempt, but without attaining immediately the results indicated.

It is here clearly seen how a theoretical concept or a happy hypothesis devised to guide the experimenter can be of the greatest assistance in obtaining far-reaching results. In fact, it is difficult to decide which most to admire in Thomson—the ability of the proved experimenter or the felicitous intuition of the keen thinker which leads him to foresee and anticipate the final interpretation of the facts observed. Even to-day it would require most prolonged and difficult experimental work to show in a rigorous manner that the ratio e/m is really (save the influence of v on the value of m) constant on all occasions, whatever be the circumstances in which the kathode rays originate (the nature of the electrodes, of the rarefied gas, the pressure of the latter, &c.). But with inspired generalisation, Thomson, conscious of the accuracy of his own measurements, and with great faith in the conceptions that were becoming matured in his mind, did not hesitate to proclaim that his experiments furnished the proof of the existence of particles negatively electrified and having a mass not greater than one two-thousandth part of the mass of the atom of hydrogen.

With this was assumed that the charge of each was equal to that corresponding with one atomic valence; but in strictness the results obtained could have been interpreted alternatively by attributing to the said particles somewhat large charges and a mass of atomic magnitude. However probable the first interpretation seemed, there still remained a gap to fill in. Thomson succeeded in this by utilising the studies carried out in his laboratory by C. T. R. Wilson, who had recognised that electrified particles, and more particularly the negative ones, acted as nuclei of condensation for water vapour. The experimental method adopted by Thomson, which enabled him to evaluate the charge of each single corpuscle, is a true model of ingenuity. The numerical result obtained was perfectly favourable to the interpretation adopted in the earlier experiments; and if not at first very exact, was soon corrected by the later experiments of H. A. Wilson and of Thomson himself.

When the results were first communicated to the British Association in 1899, they were so favourably received that it may be said that from that date the new ideas on the nature of the kathode rays were accepted by the majority of physicists.

Meanwhile other discoveries of considerable importance were made, which brought unexpected confirmation to these hypotheses. The phenomenon discovered by Zeeman, which was at once explained by the electronic theory of Lorentz, and the discovery of radio-activity by Becquerel, came at the most opportune moment in support of the electrical theory of matter, which now became almost irresistible and had its basis in the experiments of Thomson which have been recorded.

It was not, in fact, possible to conceive how the kathode rays could be composed of corpuscles always identical whatever the nature of the bodies present, or taking part in their formation, without supposing that such corpuscles pre-existed in the atoms of every substance, and were thus identical with the electrons already assumed to be constituent parts of the atoms. From this to the hypothesis that the atoms consist only of electrons is a short step. And, in truth, the mass of the corpuscles may be entirely electromagnetic, that is, due solely to the motion with which the electrical charges are possessed. The well-known experiments of Kaufmann also came at an opportune moment in support of this opinion, demonstrating as they did that the mass of the electrons emitted by radio-active bodies appears so much the greater the greater their velocity. Thus, from experiments on the kathode rays a theory was evolved the philosophical import of which is evidently of the highest, inasmuch as it enables one to eliminate one of the fundamental or primitive entities (matter) which have been invoked to give an explanation of the phenomena of the physical world.

One can conceive, in fact, the possibility of building up a system of philosophy with only æther and electrons as a basis; a system all the more seductive on account of the simplification that it carries with it.

The known dualism of electricity of two signs, which causes differences more or less considerable in every fact, becomes accentuated when the single electrons are considered. In fact, in spite of the numerous and varied attempts that have been made to demonstrate the existence of positive electrons, that is, of positive charges endowed with a mass (electromagnetic) of the same order of magnitude as that of the negative electrons, all such efforts have ended in failure. It is, therefore, natural to consider only the negative electrons, from which one may eliminate the adjective, and admit that in the positive ions each valence is due, not to the addition of a positive electron, but to the subtraction of a negative electron or electron strictly so called. This naturally led Thomson to attribute to positive electricity certain special characters within the atoms, and to assume for these a special structure in which the negative electrons have a preponderating influence; which view is in conformity with known facts, and, in particular, with the Zeeman effect, from which is deduced, as is well known, that the emission of light has its origin in the vibration of negative electrons.

Taking, as point of departure, an idea suggested by Lord Kelvin's "Aepinus Atomised" (according to the picturesque expression employed by him), Thomson assumed that a neutral atom is composed of a sphere of positive electricity in which are immersed negative electrons, the total charge of which is equal in absolute value to that of the sphere. The electrical force which acts on each of these throughout the positive sphere is proportional to the distance from the centre, and maintains them in closed orbits, the stability of which needs a special distribution of the electrons themselves.

Some concrete idea of such a species of solar systems was opportunely found in the old experiment of floating magnets, due to the physicist Mayer, which was thus rescued from the unmerited oblivion in which it had been left.

This hypothesis of the structure of the atoms, although most daring, seems to respond to all exigencies. It may be modified with the progress of time, and certainly needs completion; but it is probable that its essential features will be retained by the science of the future.

A necessary complement of the present-day theory of the kathode rays is found in the theory elaborated in much detail by J. J. Thomson to explain the production and nature of the rays discovered by Röntgen. It presents such a character of evidence, and, in short, is so intuitive, that everyone feels that he could have conceived it himself, which idea, however, is only one of many similar illusions of *amour propre*. Indeed, how can one avoid admitting the production of sudden electromagnetic perturbations in the æther, at the spot where the electrons are entirely arrested or retarded, as occurs when the kathode rays encounter an obstacle? It will naturally follow, I believe, that the X-rays will be considered as the manifestation of those perturbations, in spite of there having been proposed recently a new hypothesis, according to which these rays are of a corpuscular nature and composed of the motion of neutral couples (one negative electron and one positive). It will be necessary at least to bring proof on proof for this new hypothesis before Thomson's theory is abandoned. And in such a case it will be necessary to establish what happens to the perturbations due to the variations of velocity of the electrons constituting the kathode rays, which undoubtedly are produced.

In creating the actual current of ideas relative to the nature of matter and the common prime cause of phenomena of light and electromagnetism, in addition to the experimental work of Thomson other discoveries of recent years have contributed, above all, that of Zeeman (1897), to which I have already alluded, and that of radio-activity—the latter thanks to the very simple and ingenious explanation given by Rutherford and Soddy. If from the measurements carried out on the kathode rays was demonstrated the existence of the electrons as integral parts of the atoms, the facts of radio-activity lead us further—to the view that the atom is a complex structure of negative electrons and positive ions, or at least that at a given moment, perhaps in consequence of the continuous irradiation of part of its energy, there can separate electrons and positive ions, the latter being, at any rate in the cases studied as yet, not other than bivalent ions of helium. This interpretation of radio-active phenomena seems so natural as to give rise easily to the illusion that the phenomena themselves could have been foreseen. On the other hand, they may make the importance of Thomson's work appear to some less than it undoubtedly is; but it is necessary to go back in mind to the period at which it was carried out and take account of the mode of thought prevailing at the time, to appreciate the acuteness and originality of mind which were necessary in order to dare to snatch from the atom its dogmatic prerogatives of indivisibility and invariability.

There are other examples in the history of physical science of discoveries made at short intervals of time converging to a truth which the discovery of a final fact put into a clear light. It is usual then to say that that truth was "in the air," as if any person in favourable circumstances would have been able to discover it. I do not believe, in any case, that the same can be said of the discoveries of which we are speaking; moreover, such an opinion, too frequently repeated, should be rejected. If one looks closely, it is possible to recognise that, in the majority of cases, not blind fortune is the aid of the happy discoverer, but the special attitude of mind and the scientific preparation he possesses. In the concrete case it is evident that Thomson, from the commencement of his researches, was unconsciously preparing himself for the grand discovery of the true nature of the kathode rays. It is sufficient in proof of this to cite his noteworthy memoir of 1881, relative to the electrical and magnetic effects produced by the motion of electrified bodies, for which Crookes's theory of radiant matter had furnished the inspiration.

The work published by Sir J. J. Thomson during recent years constitutes the complement and crown of his principal achievement. Thus, in a short time he was able to collect into a body of doctrine everything which relates to the propagation of electricity in gases, and of which his well-known treatise on the subject is the embodiment of the faith—a work that is consulted by all who conduct experimental researches in this field, which is very far from having yielded all its fruits. In this volume are treated with much detail the production of ions in gases, their disappearance, their velocities under certain contingencies, &c. Frequently the original experiments of the author and his students have rendered possible the completion of the explanation of a particular phenomenon, or put in evidence some new detail or the laws which it obeys. Moreover, making use of the facts thus accumulated and the relationship existing between them, Thomson had at his disposal the elements necessary to found a theory of electrical discharge more comprehensive than any previously proposed, which, although not yet complete and definitive, has enabled him to point out the relations between facts apparently disparate which previously could only be described separately and disconnectedly.

Quite recently the activity of the Cambridge physicist seems to have been concentrated on the study of the properties of the positive rays, and especially of the so-called canal rays. This is a field of studies in which several most daring workers (Wien, Stark, &c.) have amassed a rich harvest of most important results; none the less, J. J. Thomson, by the adoption of ingenious experimental arrangements, in part new, and especially by virtue of happily inspired and most original interpretations, has drawn, and continues to draw, from his researches consequences the import of which far surpasses the limits in which they might have been expected to be confined.

Of these researches physicists await with some impatience the publication of a treatise which shall present them not merely in order of date, but with that arrangement, clearness and concision which are precious characteristics of Thomson's writings.

However insufficient and incomplete, the foregoing considerations will help to make clear the signal value of Thomson's work. Such, at least, has been my intention. Although compelled to abandon an analysis of the extensive scientific productions of the great physicist, I trust that all will be, like myself, convinced that his work belongs to the category of those investigations which leave an indelible impress on the progress of science.

Augusto Righi.

AN ENGLISH TEXT-BOOK OF PROTOZOOLOGY.

An Introduction to the Study of the Protozoa: with Special Reference to the Parasitic Forms. By Prof. E. A. Minchin, F.R.S. Pp. xi + 520. (London: Edward Arnold, 1912.) Price 21s. net.

THIS work on the Protozoa by Prof. Minchin may be considered as an attempt to confine a knowledge of the philosophical and the practical side of the modern science of protozoology within the limits of one volume.

After discussing the one-celled organisms grouped for convenience under the term Protista, their modes of life are considered. Various types of nutrition—purely animal, plant-like, feeders on decaying matter, and finally parasitic methods—are described and illustrated. The "mutual aid" associations of the animal world known as symbiotic unions are charmingly portrayed, and in contrast the interrelations of hosts and parasites are set forth. A most interesting study in animal mechanics is presented, together with a broad account of the organisation of the Protozoa. To the cytologist there is much of interest in the chapter dealing with the nucleus and nuclear structure. The author draws a distinction "between organisms of the 'cellular' grade, with distinct nucleus and cytoplasm, and those of the 'bacterial' grade, in which the chromatin does not form a distinct nucleus." He considers that a "bacterial type of organism" is "not to be regarded as a cell, but as representing a condition antecedent to the evolution of the true cellular type of structure." Such a distinction seems somewhat arbitrary and unnatural, and tends to overlook the importance of intermediate forms.

The problems of the propagation and perpetuation of races of organisms and the modes of transference of the parasitic forms are both of great interest and of economic importance. The parasites have multiplicative methods of reproduction which are necessary for the increase of their numbers within one host, while propagative forms are produced for their transference to other hosts. The function of syngamy (fusion of gametes) as a factor in keeping the tendency to variation within the specific limits is a view worthy of more attention. The many forms assumed by one organism (polymorphism) are traced as arising from adaptation to environment, to growth and development, and to sexual differentiation. The general part of the book closes with an interesting chapter dealing with the vital physiological phenomena shown by Protozoa.

Following the general consideration of the Protozoa, eight chapters are devoted to an account of their systematic grouping, and the enormous extent of the group can be realised by scanning the sequence of genera or by referring to the copious index. Prof. Minchin considers that two types of organisation prevail among the Protozoa. The simpler or Sarcodine type possesses no permanent locomotor organs when mature, although such may be present in its youth form. The second or Mastigophoran type, comprising organisms often of small size, has permanent locomotor organs, flagella, which are lost in the resting phases. Subdivisions of each group are numerous. The very diverse organisms among the Rhizopoda, such as the Amœbæ, the sun-animalcules (Helizoa), the chalk and ooze-formers known as Foraminifera and Radiolaria, and the Mycetozoa (claimed also by the botanist as the slime fungi or Myxomycetes), are all considered. Perhaps some newer illustrations would be an improvement here.

The bionomics of the flagellates are of much interest, whether the parasitic forms or the tiny inhabitants of ponds (also claimed by the botanist as Algæ) are under discussion. The interest of the medical man will be claimed by the accounts of the sleeping-sickness parasites, and the causes of such diseases as kala-azar, oriental sore, and malaria. The agriculturist should be interested in the parasites of red-water and East Coast fever, so fatal to cattle, as well as in the accounts of Coccidia, fish tumours, and silkworm disease. Incidentally, it may be mentioned that Prof. Minchin does not now accept the results of Schaudinn's researches on the parasites of the little owl.

Certain organisms, considered by some as doubtfully Protozoa, such as the Spirochætes, causing African tick fever and relapsing fever, and the bodies responsible for small-pox, are briefly considered in the concluding chapter. Those who care for possible genealogies and speculations will also find here an account of the possible evolution and ancestry of the Protozoa.

In conclusion, it is a pity that certain blemishes in the form of loose statements, some inconsistencies of nomenclature (for example, the use of Coccidium, Piroplasma), and slightly partisan views on some contentious subjects have been allowed to creep in and mar the book, but doubtless these will disappear in the second edition. We would also suggest that an increase in the number of illustrations would be a very great advantage, and this should not be incommensurate with the cost of the book (21*s.* net). Some rather old figures could be replaced by others embodying the results of more recent and accepted research. Criticisms of technique employed some years ago are obviously futile, inasmuch as the said technique was the best available at the time. Also we are distinctly of opinion that the systematic part of the book should be enlarged. But it must be recognised that the task before Prof. Minchin was an enormous one, and he is to be congratulated on the successful issue of the work.

CHEMISTRY AND ITS APPLICATIONS.

A Dictionary of Applied Chemistry. Revised and enlarged edition. By Sir Edward Thorpe, C.B., F.R.S., assisted by eminent contributors. Vol. ii. Pp. viii+786. Vol. iii. Pp. viii+789. (London: Longmans, Green and Co., 1912.) Price 45*s.* net per volume.

As a notice of the first volume of the new edition of Thorpe's Dictionary appeared in the columns of NATURE for April 18, 1912, it is not necessary on the present occasion to do more than express cordial concurrence in the reviewer's high estimate of the character of the work and of the services rendered to the chemical world by the editor and his staff of contributors. In the two volumes before us the reader rather naturally turns first to those articles which specially illustrate the applications of science to industry, namely, those of which the subjects had not even come into practical existence at the date of the former edition. Metallography, for example, is one of these subjects, and is treated in a thoroughly masterly manner by Dr. Walter Rosenhain, of the National Physical Laboratory. Here is a subject which, originating fifty years ago in the microscopic study of rocks by Sorby, has been largely dependent for the advances already made on the provision of instruments for measuring and recording temperatures above the range of the mercurial thermometer. Without the electrical pyrometer comparatively little would have been accomplished.

Another subject of the greatest chemical and commercial importance is the utilisation of atmospheric nitrogen, which has been treated in a complete and interesting article by Prof. Crossley. Up to the present the fixation of nitrogen in the form of nitrate has perhaps attracted most attention, and has been practised on the largest scale, but the recent announcement that the Badische Anilin- u. Soda-Fabrik has actually started the manufacture of ammonia from the combination of gaseous nitrogen and hydrogen by Haber's process is a further step of great significance.

Among other new subjects unrepresented in the former edition are "Colloids," by Dr. J. C. Philip, and "Corrosion and Fouling of Steel and Iron Ships," by Prof. Vivian B. Lewes; while several others, such as "Explosives," by Mr. G. H. Perry, and "Matches," by Mr. E. G. Clayton, have been largely added to and brought up to date. There is also a judicious unsigned historical article on the liquefaction of gases.

There are few deficiencies apparent on first acquaintance with the dictionary, and in the presence of so much that is admirable, hypercriticism may be deprecated. The inequality in length of the various articles is probably one of the most difficult questions which come before the editor in relation to such a work as this. The most glaring case noticeable in the two volumes before us is the assignment of 100 pages to naphthalene, while fuel receives only twenty-four pages and flame eight pages. In neither of these articles is there any reference to the important question of smoke production and prevention, which is surely a question of chemical as well as practical interest.

The attention of the editor may also be directed to the fact, though too late for remedy, that the article on essential oils, though containing much useful information, is distinguished from every other important article in the book by the absence of references or bibliography. It would probably provide a slight shock for Prof. Wallach to find that an article on this subject could be written without mention of his name. The writer of the article similarly ignores Schimmel's half-yearly reports, which furnish a large body of valuable information extending over many years, and cannot yet be considered to be replaced in this country by *The Perfumery and Essential Oil Record*.

All British chemists will certainly make frequent use of the new edition of the dictionary, and in doing so the majority will be glad of the adoption of a system of abbreviations of the titles of journals and books which is practically identical with the system with which all are familiar in the publications of the Chemical Society, and is much to be preferred to the contractions, often rather tiresome, used in the previous edition.

W. A. T.

PRACTICAL MATHEMATICS.

(1) *Practical Geometry and Graphics.* By E. L. Bates and F. Charlesworth. Pp. ix+621. (London: B. T. Batsford, 1912.) Price 4*s*. net.

(2) *Practical Mathematics.* By E. L. Bates and F. Charlesworth. Pp. ix+513. (London: B. T. Batsford, 1912.) Price 3*s*. net.

(3) *Analytical Geometry. A First Course.* By C. O. Tuckey and W. A. Nayler. Pp. xiv+367. (Cambridge: University Press, 1912.) Price 5*s*. net.

(4) *A Preparatory Arithmetic.* By C. Pendlebury. Pp. xiv+185+xxx. (London: George Bell and Sons, Ltd., 1912.) Price 1*s*. 6*d*.

(5) *Les Anaglyphes Géométriques.* By H. Vuibert. Pp. 32. (Paris: Librairie Vuibert, n.d.)

(1) THE contents of this volume fall into three sections: (*a*) plane geometry; (*b*) graphics; (*c*) descriptive geometry. The first deals with the calculation of areas and volumes, the fundamental geometrical constructions and the chief properties of the circle and conic. In the second the student is shown how to apply graphical methods to the solution of practical problems in mechanics, considerable space is devoted to the consideration of harmonic motion and systems of frameworks, and allusion is made to the use of vector products. The last section, which occupies nearly 200 pages, contains as full an account of the methods of practical solid geometry as any ordinary technical student is likely to require. The diagrams are clear and the quality of the examples is distinctly good.

(2) The authors have attempted to collect in as concise a form as possible all those portions of mathematics which are likely to be of use to practical students. The volume is self-contained in the sense that no previous knowledge is assumed, and its contents are designed to supply material for a course lasting between two and three years. About two-thirds of the book is devoted to arithmetic, algebra and geometry; due prominence is given to graphical methods; the treatment of mensuration is excellent, and the selection of those geometrical properties and ideas with which it is considered students should be familiar has been made with great care. The concluding part of the

book develops the fundamental ideas of trigonometry, vector geometry, mechanics, and the calculus. Considerations of space have made this section somewhat brief, but it should prove useful to those who regard it as an introduction to more advanced text-books.

(3) The distinguishing feature of this work is the early introduction of the equations of curves of the second and higher degrees. It is an undoubted fact that if a student is compelled to make himself thoroughly familiar with the analytical geometry of the straight line and circle before proceeding to other loci, he finds it hard to appreciate the purpose and the value of the work in which he is engaged. The boy who intends to specialise in mathematics will not derive any harm from pursuing this course; in fact, there is much to be said for giving him a sound grounding in the elementary principles at the outset; but those who are taking scientific or engineering courses, and therefore require less manipulative skill, secure what they need from a course which is less detailed and more general in character. Their requirements are met admirably by such a treatment as is given in the work before us. This will be made clear by a brief enumeration of the subjects and the order in which they are taken: (1) standard equations of the straight line, circle, ellipse, parabola, hyperbola; (2) gradient of curves; (3) locus problems; (4) polar coordinates with applications to the limaçon, cardioid, cycloid, etc.; (5) the conic based on the focus-directrix definition; (6) the solid geometry of the plane, straight line, and simple curved surfaces.

There is an excellent collection of examples, answers to which are given at the end of the book. We would suggest that an index should be added in future editions.

(4) During the last ten years a number of valuable reports on the teaching of elementary mathematics have been issued by the Mathematical Association, and they have exercised a very considerable influence on the curriculum and the methods employed. As evidence of this it is necessary only to refer to the changes which examining bodies have made in their regulations and to the alteration in character of modern text-books. The present work is based on the report dealing with the teaching of arithmetic in preparatory schools. Concrete and abstract questions are taken side by side, those parts of the subject which are of small intrinsic importance are omitted, and the artificial divisions of the subject-matter into a number of standardised types of problems are avoided. We have no hesitation in recommending this book for use with junior students.

(5) This pamphlet describes a means of exhibiting three-dimensional figures, examples of which were shown at the International Congress at Cambridge last August. Two perspective figures are drawn close together on the paper in the complementary colours green and red, and they are viewed through red and green transparent screens. A highly striking effect is obtained. It is clear that the simplicity of the method will contribute largely to its practical utility. For purposes of demonstration, in the teaching of solid geometry, it should be invaluable. About thirty examples are given; the diagram which represents a cube with one diagonal vertical with its plan and elevation is particularly good. The figures of the cylinder seen from one end and the section of a tetrahedron by parallel planes appear to be a trifle out of drawing.

OUR BOOKSHELF.

Télégraphie sans Fil: Reception des Signaux horaires et des Télégrammes météorologiques. By Dr. Pierre Corret. Pp. 93. (Paris: Maison de la Bonne Presse, n.d.) Price 1 franc.

THIS little volume gives simply-worded directions for the construction of apparatus that will enable persons interested to make use of the time signals dispatched regularly from the wireless telegraph station at the Eiffel Tower. The author begins with a description of the very simple apparatus required by a Parisian amateur, and gives a clear account, with fully detailed examples, of the time signals and the meteorological messages from the tower. From his story of a day's programme of the tower, including as it does telegraphic exercises with other French stations as well as regular service messages, it would appear that the amateur in the French capital has excellent opportunities of learning Morse with a very small outlay on apparatus.

The next two sections of the book give instructions for erecting a receiving station of sufficient sensitiveness to pick up the messages at distances of two or three hundred miles from the tower. These directions are plain and sufficient. With the apparatus described, a French amateur may listen to a great variety of Spanish, Italian, German, and English messages; and an entertaining programme is made out for him in the book. Here the information conveyed is just such as will help those amateurs who are in a state of mental fog as regards the origin of the signals they listen to, and the information will be almost as useful to English as to French amateurs. The book closes with an account of the system of signalling time adopted by the international conference of October last.

It is intended that different stations shall transmit certain signs at different hours. Those normally audible in England are Paris at midnight and 10 a.m., Norddeich at midday and 10 p.m. At present, it may be remarked, the Paris signals indicate 10.45 a.m. and 11.45 p.m.

The receipt of these time signals is so easy a matter that every observatory, and every other institution or person needing accurate time, ought to take advantage of them.

(1) *School Gardening, with a Guide to Horticulture.* By A. Hosking. Pp. xi + 326. (London: W. B. Clive, 1912.) Price 3*s.* 6*d.*

(2) *Plant Geography.* By Prof. G. S. Boulger. Pp. viii + 136. (London: J. M. Dent and Sons, Ltd., 1912.) Price 1*s.* net. (The Temple Primers.)

(1) MR. HOSKING has produced a useful book, or rather three small books, under the title of "School Gardens." The second part deals with soils, manures, and the cultivation of garden crops; while part iii. is devoted to garden pests and miscellaneous information.

Part i., which gives the title to the book, is to us the section of most interest and value, and we would gladly have seen it expanded at the expense of the other portions of the book which require treatment on a more generous scale. On the subject of school gardens the author can speak with a full experience, and his practical details throughout are concise and thoroughly to the point.

The school garden must not be considered in the light of a paying venture. Its value will only appear when the pupils have become settled in life; then the stimulus to observation and method and the interest in outdoor pursuits they received will be fully appreciated, and the experiment will reap sufficient reward.

(2) In the small compass of 136 pages Mr. Boulger has succeeded in compiling a very readable account of plant geography. The four divisions of the book deal with the evolution of the plant world, the factors of distribution, floristic regions, and botanical ecology or topography. He has wisely devoted the larger part of the book to the consideration of factors of distribution rather than to detailed accounts of the floras of different regions, since the science of plant geography is so fundamentally bound up with the proper understanding of the ways and means of plant dispersal.

Mendel's Principles of Heredity. By W. Bateson, F.R.S. Pp. xiv + 413. (Cambridge University Press, 1913.) Price 12*s.* net.

A REVIEW of the first edition of Dr. Bateson's valuable conspectus of discoveries in regard to heredity made by the application of Mendel's methods of research, appeared in NATURE of May 25, 1911 (vol. lxxxvi., p. 407). Since then a vast amount of work has been done upon various subjects of Mendelian analysis; and Dr. Bateson has endeavoured to take account of this by a series of appendices giving descriptive references to papers representing advances upon the state of knowledge when the original volume was published. Short of rewriting the book, this was probably the best means of giving a new lease of life to a standard work upon Mendelism by a leading exponent of its principles.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Spectra of Neon, Hydrogen, and Helium.

IN the issue of NATURE for February 27 (p. 699), Prof. Collie and Mr. Patterson have directed attention to numerous approximate coincidences between lines of neon and hydrogen, from which it is presumably intended to be inferred that certain lines of neon are ordinarily present in the vacuum tube spectrum of hydrogen. A further examination of the observational data, however, seems to be desirable.

Messrs. Collie and Patterson have omitted to state that in the region considered, λ6507 to λ3472, Watson's list of the secondary spectrum of hydrogen contains more than 700 lines, while that of neon contains 260 lines, of which nearly 100 are of intensity 4 or greater. With spectra of this complexity there is nothing at all remarkable in the occurrence of a considerable number of approximate coincidences between lines belonging to the two spectra. As stated by Messrs. Collie and Patterson, there are, in fact, twenty neon lines of intensity 4 and upwards which fall within a quarter of an Angström unit of lines of hydrogen; while, if all the neon lines are included in the comparison, and differences of wave-length amounting to a whole Angström unit be allowed, the number is brought up to 110.

Messrs. Collie and Patterson, however, do not seem to have realised the accuracy of modern spectroscopic tables, such as they have utilised in the present comparison. A difference of more than a few hundredths of an Angström unit in the tabulated wave-lengths of two lines should now suffice to prove that they have different origins, unless other evidence of probable identity is forthcoming. If the permissible discrepancy be reduced to one-twentieth of an Angström unit, there remain only six lines which might be regarded as possibly common to the two spectra, namely:—

Neon Intensity	Neon Wave-length	Hydrogen Intensity	Hydrogen Wave-length
5	6175·09	0	6175·14
7	6143·31	0	6143·30
7	5343·40	0	5343·43
4	4537·93	0	4537·91
9	3520·61	1	3520·60
6	3472·68	0	3472·65

Thus, of the hundred brightest lines of neon, only six are found in hydrogen within the probable limits of error, and only one of the six brightest is among them. There is no evidence that the six "coincident" neon lines have special properties which would favour their survival, and the coincidences cannot, therefore, be properly regarded as significant. Even twenty such coincidences would not prove a relation between the two spectra, unless it could be shown that the lines in question were the most persistent of the neon spectrum.

A very similar result is indeed obtained when a comparison is made between neon and iron. Over the same range of spectrum there are thirteen of the hundred brighter neon lines which differ by no more than one-twentieth of an Angström unit from iron lines, but this would scarcely be accepted as evidence of any relation between the two spectra.

As regards the comparison of neon with helium, the mean deviation of the three lines noted is 0·16, which is probably considerably greater than can be attributed to errors of measurement. Moreover, helium lines occur in connected series, and there is no justification for supposing that one of them would be represented in the absence of other members of the same series. The oxygen line 5330·84, which, it was pointed out, is nearly coincident with neon 5330·90, is one component of a triplet forming part of a series, and would not appear in the absence of the associated lines.

To my mind the proper conclusion to be drawn from the comparisons is that the respective spectra are quite distinct, and that the approximate coincidences are entirely accidental. A. Fowler.

South Kensington, March 3.

The Influence of Icebergs on the Temperature of the Sea.

Prof. Barnes, in Nature of February 20, gives an important piece of information which seems to me to enable us to clear up the confusion at present surrounding this subject, as it explains the reason for the different results obtained by Prof. Barnes in his earlier and later observations, and why his results differ from those of previous observers; and it also helps us to an explanation of the puzzle of the rising temperature of the sea on approaching icebergs, found by Prof. Barnes. The earlier observers made their tests in the cold but weak sea-water floating on the surface. Prof. Barnes's first tests were made at a depth of 5 ft. The first part of his curve, Fig. 1 (Nature, June 20, 1912), gives the temperatures of the sea as the thermometer passed under the outer edge of the cold surface water, and was thus made in the ordinary sea-water, and gave the temperatures below the cold surface water, until the ship arrived within a mile of the iceberg, where the increasing depth of the cold surface water began to affect the thermometer, and from that distance, the thermometer being now in the cold surface water, the temperature fell rapidly as the ice was approached. The thermometer in Prof. Barnes's second ship, he tells us in his last letter, was placed at a depth of 18 ft. below the surface, and seems to have been always too deep to get into the cold surface water.

We now come to the question as to why these last observations of Prof. Barnes show a constant rise in the temperature of the water as icebergs were approached. We can scarcely imagine ice to have any heating effect, and solar radiation does not seem to meet the case. It would, however, appear that we do not require to call in the aid of sunshine, or other outside source of heat, to explain this rise in temperature, as it can be more simply accounted for by the indraught current near the surface having to dip below the cold surface water, its upper warmer water being thus carried downwards towards the thermometer. By this explanation there is no heating of the water as it approaches the iceberg, but the warmer surface water coming from outside the cold surface area is carried underneath the cold water to lower levels, so giving a rise of temperature at these levels.

If the above explanation be correct it would appear that the surface cold current is the one to be mainly depended on for indicating the presence of ice, because, unless there is some depth of cold surface water, there will be no depression of the inflowing current, and therefore no rise of temperature on approaching the iceberg. Perhaps the best method of observing would be to have two thermometers, one near the surface and the other at a depth of, say, 18 ft., writing on the same paper. Under ordinary conditions these two would show nearly a constant difference, but would tend to diverge on the approach of ice, so checking each other, and magnifying the indications.

John Aitken.

Ardenlea, Falkirk, February 22.

Systems of Lines obtained by Reflection of X-Rays.

In continuation of the experiments of Mr. W. L. Bragg (Nature, December 12, 1912, p. 410), we have investigated the reflection of X-rays by mica and rock salt. In these experiments we found that in general two dark spots are obtained in consequence of the reflection, one of which is crossed by equally-spaced lines, which run at right angles to the plane of reflection. The distance between the different lines increased with increasing distance of the photographic plate from the crystal, and appeared greater with rock-salt than with mica. In some photographs the second spot was also striated.

The plates cut from the crystals were fastened down to aluminium foil 0·2 mm. thick. Successful photographs were only obtained with rays of grazing incidence, an angle of about 80° being used in most cases.

The regularity in which the fringes were distributed suggests that the phenomenon is due to interference. Further experiments are, however, required before this question can be definitely settled. Since Prof. Barkla and Mr. Martyn (Nature, February 13, 1913, p. 647) have recently described similar results, it may be desirable to publish our preliminary results, of which a more complete description will soon be communicated to the German Physical Society.

E. Hupka.
W. Steinhaus.

Physikalisch-technische Reichsanstalt,
Charlottenburg, February 23.

Four-horned Sheep in Scotland.

So little seems to be known regarding the early occurrence of Scottish four-horned sheep that the following record will bear repetition. It occurs, almost as an aside, in the account of the parish of Moffat, in the lowland counties of Dumfries and Lanark, published in Sir John Sinclair's "Statistical Account of Scotland," vol. ii., p. 292, 1792. The writer of the account, Rev. Mr. Alex. Brown, says:—"It is not long since the sheep in this part of the country, were of the four-horned kind; a few of which, it is said, remain still in some parts of Nithsdale. Their body is smaller, but their wool finer than those of the present breed. Their want of weight for the butcher, and greater difficulty and danger in lambing have banished them from this place."

This lowland four-horned race agrees with the Hebridean in the characters of fineness of wool and smallness of body. It also appears to agree in the less tangible character of maternal inefficiency, for of an experiment carried out in a small Western Islands' flock in the Isle of Man a few years ago Prof. Wallace says ("Farm Live Stock," p. 521, 1907):—"The animals weighed only 5 lb. to 6 lb. per quarter, and they proved to be such indifferent nurses that they were eventually put away"—causes remarkably similar to those which "banished them" from south Scotland. At any rate, it would seem clear that the four-horned breed of sheep, the last remnants of which in Scotland were isolated on the Hebridean and Western Islands, had at a comparatively recent date considerable outposts on the mainland. James Ritchie.

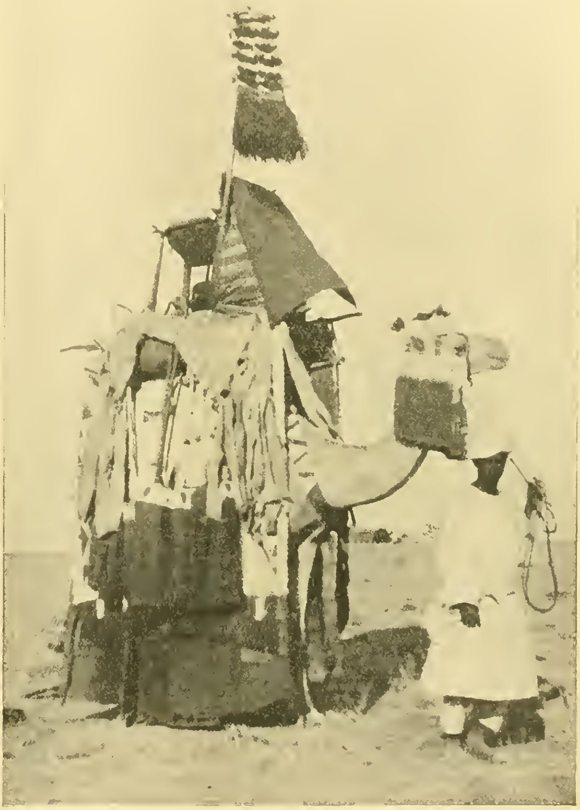
The Royal Scottish Museum, Edinburgh,
February 26.

THE TRIBES OF NORTHERN AND CENTRAL KORDOFAN.[1]

IN many ways this is a most interesting and suggestive volume, nor can its significance be measured entirely by the number of new and important facts recorded in it. If we except Mr. J. W. Crowfoot's archæological studies, not only is this the first piece of precise work of any magnitude dealing with an ethnological subject produced by an officer in the service of the Anglo-Egyptian Sudan, but since the Government has borne the expense of its publication it furnishes a further example of that enlightened spirit which has already led the Government to find the funds necessary to start an ethnographical survey on a small scale. Considering that the part played by the Sudan Government in the production of this volume is perfectly well known, it is perhaps a pity that the book contains no definite statement on the subject, since its appearance may be looked upon as the first fruits of the sensible forward scientific policy in favour in the Sudan. This, indeed, is the aspect of general public importance with which ethnologists and historians are most concerned.

There is, of course, another point of view, which no doubt specially appealed to the representatives of the Intelligence Department. During the years of residence and travel in Kordofan Mr. MacMichael accumulated a fund of knowledge concerning the quarrels, wanderings, and relationships of both the sedentary and nomad Arab tribes of the province. Part of this had perforce to be acquired as the country was opened up by the new administration, but the remainder of the really vast stores of hitherto unpublished and recondite historical information brought together in this volume was collected as a labour of love, and constitutes a corpus of information concerning the history, sociology, or ethnology of Kordofan. While all interested in these subjects should be grateful, Mr. MacMichael's successors responsible for the present and future administration of the province will most profit by his labours, for it is not too much to say that a collection of facts such as this, put in the hands of an intelligent newcomer and properly used, must reduce the doubts and difficulties of administration by 50 per cent.

Southern Kordofan, Dar Nuba, does not come within Mr. MacMichael's purview; in this he follows the native idea, for neither Arabs nor blacks include Dar Nuba in Kordofan. In spite of this, Mr. MacMichael has rightly included the Baqqara, and he has added to the interest and



A Kabábish camel with "utfa" ready to transport the daughter of the wife of a sheikh from one camping ground to another. (Note the leather work and cowrie shells). From "The Tribes of Northern and Central Kordofán."

scientific value of the book by chapters on Jebel Midob and the little-known Zaghawa. The former is a hill *massif* some forty miles long on about the same latitude as Omdurman, but so far west as to be in Darfur territory. From the details concerning its inhabitants, now for the first time available, there can be little doubt that these non-Mohammedan "black black slaves" (as the

[1] "The Tribes of Northern and Central Kordofán." By H. A. MacMichael. Pp. xv+259. (Cambridge University Press, 1912.) Price 10s. 6d. net.

Kababish called them to the writer) are the surviving representatives of the old Nuba population of the hills of northern Kordofan, the remains of whose houses can be seen on so many hills. In spite of the contemptuous tone taken by the nomad Arabs when speaking of these folk, they are bold raiders, and do not hesitate to cross the border to lift the cattle and camels of even the strongest tribes, the herdsmen of which they kill or enslave as opportunity offers.

The Zaghawa are Hamiticised negroids who about the end of the eighteenth century emerged as a vassal State in northern Darfur under practically independent rulers. It was probably about this time, or a little earlier, that a party of Zaghawa migrated eastwards and seized the hills in the neighbourhood of Jebel Kagmar in northern Kordofan, where they settled and which their descendants still occupy, though none of these can speak a word of any language but Arabic, and have adopted a pedigree dating back nineteen generations to Khalid el Guhani, the brother of Abdulla el Guhani, to whom the usual faked *nisba* of the tribes of the northern Sudan goes back.

The mere mention of these two matters will serve to give some idea of the value and scope of the book.

A MEMORIAL TO SIR JOSEPH HOOKER.

A MEMORIAL to the late Sir J. D. Hooker, which has been placed in the Parish Church at Kew, near the similar memorial to his father, Sir W. J. Hooker, was unveiled by Lady Hooker in the presence of members of the Hooker family on Saturday, February 22. The memorial consists of a mural tablet of coloured marble bearing the following inscription:—

1817–1911 JOSEPH DALTON HOOKER, O.M. G.C.S.I. C.B. M.D. D.C.L. LL.D., ASSOCIÉ ÉTRANGER OF THE INSTITUTE OF FRANCE, KNIGHT OF THE PRUSSIAN ORDER "POUR LE MÉRITE," SOMETIME PRESIDENT OF THE ROYAL SOCIETY, FOR XX YEARS DIRECTOR OF THE ROYAL BOTANIC GARDENS KEW. BORN AT HALESWORTH 30TH JUNE 1817, DIED AT WINDLESHAM 10TH DEC. 1911. THE WORKS OF THE LORD ARE GREAT SOUGHT OUT OF ALL THEM THAT HAVE PLEASURE THEREIN.

Below this inscription is a Wedgwood medallion portrait of Sir Joseph, flanked and supported by five panels containing Wedgwood figures of plants with which, in the course of his long career, there had grown up some especial association. In the upper and corner panels, left and right, these plants are an Aristolochia, commemorating his connection with African floristic work and travel, and a Nepenthes, recalling a notable contribution to our knowledge of vegetable morphology and physiology. The left lower corner panel contains a Cinchona, commemorating Hooker's connection with one of the most humane episodes in economic botany during his lifetime—the introduction to south-eastern Asia of the medicinal Cinchonas of South America. The panel which balances this on the right contains a Rhododendron, commemorative of Hooker's great Himalayan journey.

In a smaller central panel between the lower corner ones is a Celmisia, recalling the southern voyage with Ross and the labour bestowed on the flora of New Zealand. At foot are the family arms with the family motto and the motto of the Most Exalted Order of the Indian Empire, of which Hooker was a member in the highest grade. The portrait, a head profile to left, is the work of Mr. Frank Bowcher, and is an excellent likeness, recalling the same artist's treatment of his subject in the medallion executed in 1898 at the instance of the President and Council of the Linnean Society to record the completion of Hooker's "Flora of British India" and his sixty years' services to science.

SIR WILLIAM HENRY WHITE, K.C.B., F.R.S.

BY the sudden death of Sir William White on February 27, at sixty-eight years of age, the country has lost one of her best sons and engineering science one of its leading authorities. Sir William White was born at Devonport in 1845, and started his professional life by leaving a private school in the town, in which he was at the time "head boy," and becoming a shipwright's apprentice in Devonport Dockyard.

In the fullest sense of the term the boy was "father to the man," as on entering the dockyard he occupied the highest position among those entering with him, a position which he not only maintained but improved upon by rapidly becoming higher than apprentices who had been entered before him and had had longer practical training and longer education in the dockyard school.

In 1864 a Royal School of Naval Architecture and Marine Engineering was founded at South Kensington, and to this eight shipwright apprentices were appointed, of whom Sir William was the first in order of merit. Of these only one, viz. Mr. H. E. Deadman, C.B., who was principal assistant to Sir William on his retirement from Admiralty service, now survives.

During his study at South Kensington Sir William uniformly kept highest in order of merit, and although some of his college mates, notably the late Dr. F. Elgar, formerly Director of dockyard work at the Admiralty, Mr. W. John, of Lloyd's Register, Mr. W. J. Bone, of Newcastle, and Mr. H. E. Deadman, mentioned above, achieved great distinction, it fell to the lot of Sir William to be called upon to undertake still higher work, and this work he carried out most successfully under trying conditions, often involving shortness of Admiralty staff and inadequacy of office accommodation.

On completing, in 1867, his training at South Kensington, Sir William joined the Admiralty Constructive Staff, under the headship of Sir Edward Reed, K.C.B., and at once threw himself with his characteristic zeal into all of the many difficult matters existing at that time of changing from wood shipbuilding to iron and steel shipbuilding and from unarmoured to armoured ships.

At this time the principal problems before the Admiralty naval architects were:—(1) What was the best method of constructing the armoured side of ships of the line; (2) what was the best method of disposing the armament; and (3) whether on the whole it was more advantageous to build a comparative short vessel like Sir Edward Reed's *Bellerophon*, notwithstanding the cost in machinery and coal involved in propelling each ton of her displacement, or to build such long fine-lined vessels as the *Warrior* and *Minotaur?*

Even at this early stage of his career Sir William threw much light on these questions, and, in addition, was of the utmost assistance to Sir Edward Reed in the preparation of his famous book, "Shipbuilding in Iron and Steel," published in 1869.

In 1870 Sir Edward Reed retired from his position of Chief Constructor of the Navy, and a Council of Construction, with Sir N. Barnaby (then Mr. Barnaby) at its head, was appointed to carry on the work of Admiralty naval construction. So valuable had been the work of Sir William White in the short time he had been at the Admiralty that he was retained in the position he had served in under Sir Edward Reed, and was gradually entrusted with more and more important work involving a continually increasing amount of responsibility on his part, and from then to the time of his leaving the Admiralty service in 1883 to become the head of the war shipbuilding department of Sir W. G. Armstrong and Co., at Elswick-on-Tyne, there was no work done by the Admiralty designing staff in which he did not play a very large part, which in many cases was a leading part.

In 1871 he read his first paper before the Institution of Naval Architects, which had been prepared by him with the assistance of Mr. W. John named above, and was entitled, "On the Calculation of the Stability of Ships, and Some Matters of Interest Connected Therewith."

This reading of papers before the Institution of Naval Architects he kept up for many years. They were always of first-rate importance; many of them dealt with semi-naval matters as distinct from matters of naval architecture; and the views he put forward were always met with the greatest respect. In addition to beginning in this period the contribution of papers to the Institution of Naval Architects, he commenced taking part in the discussion of papers read by other persons at the same institution, his first effort in this direction being in 1875 with respect to a paper by Mr. William Froude on the graphic integration of a ship's rolling, including the effect of resistance.

During the period of 1869–83, now under consideration, Sir William much interested himself in the education of young naval architects, and almost immediately on his appointment to the Admiralty Office in 1869 he was appointed to succeed Mr. Crossland, a member of an earlier school of naval architecture, as lecturer on naval designing at the South Kensington school. This position he retained for some years after the transfer of the South Kensington School to Greenwich, where the school still exists.

While holding this position he, in conjunction with Dr. T. Archer Hirst, the Director of Studies at Greenwich, arranged a course of instruction in naval architecture for the benefit of executive naval officers, and the syllabus of instruction was so well chosen and so wisely given effect to under his guidance that large numbers of officers were attracted to the classes, and the classes continue in effective operation to this moment.

He also at this time put forward a well-considered scheme for the formation of a Royal Corps of Naval Constructors to replace the heterogeneous system then in force, and after some amount of consideration on the part of the then Controller of the Navy, Sir W. Houston Stewart, K.C.B., and of a committee appointed for the purpose and presided over by Sir T. Brassey (now Lord Brassey), the Crown in 1883, under an Order in Council, graciously created the corps on the footing it still holds.

The chief designing work on which Sir William was engaged in this earlier period of Admiralty work, viz. 1869–83, was that of the famous *Inflexible*, with two turrets in *échelon* each containing two 16 in. muzzle-loading guns. The design of this vessel excited very strong adverse criticism, led by Sir Edward Reed. A specially competent committee was appointed to report on the design, and after long and exhaustive investigation—much of it of a practical nature at sea on actual ships, and in the experimental works of Mr. Froude—the committee reported that the design fully satisfied the conditions it set out to meet.

This design was repeated on a smaller scale by two vessels, the *Ajax* and *Agamemnon*, and by two somewhat larger, viz. *Colossus* and *Edinburgh*, although these were still much smaller than *Inflexible*. On all these vessels Sir William took a very prominent part, introducing into *Colossus* and *Edinburgh* for the first time in our line of battleships the construction of the hull of the vessel of steel instead of as heretofore of iron.

From 1883 to 1885 Sir William was engaged on warship design and was head in all respects of the warship-building branch of Messrs. Sir W. G. Armstrong and Co. at Elswick-on-Tyne. He there designed and laid down several famous vessels for foreign Powers, and laid out the Elswick shipyard for warship-building in a manner securing the utmost efficiency for building purposes.

On the expiration of this period he was appointed by Lord George Hamilton, then First Lord of the Admiralty, as Director of Naval Construction in succession to Sir N. Barnaby, then retired on account of ill-health. It has long been recognised that no wiser choice could have been made; and then commenced that portion of the work of Sir William best known to the public, although it will be seen by what has been stated above that he had already a large and very varied amount of work to his credit.

To deal adequately with the work of Sir William as Director of Naval Construction would be little short of writing a volume; and cannot be attempted here.

On rejoining the Admiralty in 1885, Sir William at once set about making improvements and developments in all classes of designs so as to embody in them all the improvements continually being made in guns, armour, and propelling machinery. Limitations of space will not permit us to describe the various type of vessels which received considerable development under his hands, and mention can be made of one or two points only.

As regards battleships, he made a special study of all the elements which go to make for fighting efficiency, having regard to the rapidly changing concurrent general features of the engineering world, and in 1889 wrote a famous paper for the Institution of Naval Architects, giving quite frankly all his views of the subject, and stating the points that had decided the Board in ordering the then new ships the *Empress of India* and her sisters. He was much criticised by many members, but it was generally felt that his views were sound. In principle and in main features they were adopted, with such extension as arose from the general increase in size and cost of ships up to the introduction of the *Dreadnought* type of ship.

Sir William received many distinctions. He was honorary vice-president of the Institution of Naval Architects, and past president of the chief engineering societies and honorary member of many others. He was elected a Fellow of the Royal Society in 1888, and was created K.C.B. in 1895. At the time of his regretted death on Thursday last he was the president-elect of the British Association for the meeting to be held at Birmingham next September, and his loss to the association will be severely felt. His name will ever be remembered in the annals of the British Navy and the records of engineering science.

PROF. ADAM SEDGWICK, F.R.S.

THE late Prof. Sedgwick was grand-nephew of Adam Sedgwick, Woodwardian professor in the University of Cambridge from 1818 until 1873, sometimes known as the "old Adam." Their ancestors had been "statesmen" in the Dale of Dent for several centuries. Adam Sedgwick, jun., was the son of Richard Sedgwick, vicar of Dent, and the affection he always bore towards his native valley was evidenced by the fact that he sent his second boy to the school at Sedbergh, at the mouth of the Dale.

Our Adam was born in 1854 at Norwich, where his great-uncle held a canonry. He was educated at Marlborough College, and after a short time at King's College, London, he entered in 1874 Trinity College, Cambridge. At that time the recently established professorship of zoology and comparative anatomy was held by Prof. Newton, and Mr. J. W. Clark was superintendent of the Museum of Zoology. Prof. (afterwards Sir George) Humphrey was professor of anatomy, and Michael Foster had recently come to Cambridge as prælector in physiology to Trinity College. A demonstrator in comparative anatomy had just been appointed by the University, and the late Prof. Bridge was the first to hold that office; a curatorship of the Strickland collection of birds was founded in the year that Adam Sedgwick came into residence, and Mr. O. Salvin was the first Strickland curator. It has not always been recognised that Cambridge led the way in the practical teaching of zoology and biology. Three years before Adam Sedgwick came into residence, J. W. Clark had, with the aid of his friend Mr. Bridge, started laboratory work in these subjects. This class-work was carried on with renewed activity by Milnes-Marshall and by Frank Balfour, and by the time that Adam Sedgwick began to be interested in zoology and to be influenced, as he was for life, by Balfour, practical classes were in full working order, although conducted in adverse circumstances of space and equipment.

Sedgwick was placed in the first class of the natural sciences tripos in the year 1877. In the same list were the names of Prof. Bower, of Glasgow, Dr. Fenton, of Christ's, and Dr. Alex. Hill, of Downing. Compared with the modern days, the tripos was insignificant in numbers, but modern days may not find it easy to equal the quality of this list. After taking his degree Sedgwick definitely cast in his lot with zoology. In 1880 the zoology class conducted by Balfour, with Sedgwick as assistant, was held in the room now occupied by physiological chemistry, at the top of Fawcett's building overlooking Corn Exchange Street.

The University was so conscious of Balfour's ability that, in 1882, he was appointed professor of animal morphology, it being understood that the professorship would lapse with his death, and that it carried but a small emolument with it. The tragedy in the Alps the same year brought this professorship to an end, and Sedgwick was left in a peculiarly difficult position. He had but recently taken his master's degree, he was but little older than some of the senior students, and the management of a comparatively large and rapidly growing department devolved on him.

Before the beginning of the October term of the same year Prof. Newton, Michael Foster, Prof. Humphrey, and J. W. Clark addressed a letter to the Vice-Chancellor, urging that the work which Balfour had so wonderfully begun should be carried on, and that the general supervision of the class should be entrusted to Sedgwick, who had been Balfour's demonstrator for some years, and had been in charge of the class during the Lent and May terms, when Balfour had been either ill or away. This was arranged, and Sedgwick was happy in securing the assistance of Mr. W. Heape, of Trinity College, and Mr. W. R. F. Welldon, of St. John's, as demonstrators, and a little later on of Mr. W. H. Caldwell, of Caius, who was then, with the aid of Mr. Threlfall, of the same college, at work on their automatic microtome.

The University was anxious to assist Sedgwick in every way in carrying on his difficult task. At the time of Balfour's death it was already building a spacious laboratory and private rooms adjoining it to accommodate students of zoology. Owing to the rearrangement of the M.B. examination, further increase soon became necessary, and this the University provided in 1884 by bodily lifting the roof off the Mineralogical Museum and building up walls under it.

Whilst Prof. Newton kept alive in the University the study of zoology as a study of living animals, Sedgwick promoted the interest of those more interested in the architecture or morphology of the animal body. He had become in 1880 a Fellow, and soon after lecturer at Trinity College, and the college (as is the habit of Cambridge colleges) allowed his University lectures to count as though they were delivered to, as they were paid for by, the college.

Sedgwick's first researches, as was natural, were on embryology, and were mainly concerned with the origin of the vertebrate kidney. He also published a short paper on Chiton, with two useful diagrams, but the work by which he will be longest remembered was his investigation into the embryology and anatomy of the Cape species of Peripatus. His investigations did much to clear up the nature of the body-cavity of the Arthropods, and to explain what had become of the cœlom in the members of this group. What he found in the developing egg of Peripatus started him on more than one interesting speculation. His views on the cell-theory, at one time much criticised, have largely come into their own. Another of his ingenious hypotheses largely based on the same research related to the origin of segmentation in metameric animals. At one time he had contemplated a final volume to his "Zoology," which was to deal with the theory and philosophy of the science, and it is very greatly to be regretted that this has not appeared. His originality of outlook and power of expression would have made it a valuable contribution to the more speculative side of zoology.

As a result of his work on Peripatus, he was elected a Fellow of the Royal Society in 1886, and he twice served on the council of that body. In 1897 he became tutor at Trinity College, and for ten years held that position. Although he continued with his usual vigour the teaching and management of a great department, this appointment practically coincided with his ceasing research. It also coincided with the production of what is undoubtedly the most comprehensive text-book in English written, with the exception of one or two groups, by one man. Sedgwick's aim in his great text-book was to mention practically every genus. Of course, in some groups, such as the insects, this ambition could not be realised; but his broad outlook, his wide knowledge, and, on certain lines, his philosophical insight have made the book invaluable to all advanced students of the subject. It will be, with his work on Peripatus, a lasting memorial to his name.

In 1907 Prof. Newton died, and the chair of zoology then passed to Adam Sedgwick, who for so many years had been the head of the department of morphology. To the great regret of his Cambridge friends he only held it for two years. In 1909 he accepted the post of professor of zoology at the Imperial College of Science and Technology, and for the last three and a half years he spent his whole energies in the attempt to build up a school of zoology in South Kensington.

For some months his friends had marked with dismay a serious decline in his health, but his sudden death on February 27 came as a shock to many who read of it in their morning paper last Friday.

If one may say a few words about his personality, he was extraordinarily "alive," very trenchant in his criticisms, not a good lecturer, the reverse of fluent, yet by his earnestness and by the vigour of his language arresting attention. Still he was a successful teacher. The best course he gave was that on embryology; here he was giving his class the results of first-hand, personal knowledge, and his students felt they were listening to a master of the subject. His very entrance into the great laboratory where some hundred students were being taught by eight or ten demonstrators put a new spirit into the thing. The atmosphere, as it were, became electrified, and teachers and taught were "keyed up." As a conversationalist he was most interesting, holding often bizarre and impossible views, and maintaining them with extraordinary energy and humour. If one may judge by portraits and statues, he was in physique very like his great-uncle—small and frail in body, his face was quick and keen. Like his great-uncle again, he was an eager and rapid worker, one who never spared himself when working at the subject to which he devoted his life.

NOTES.

THE following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society:—Prof. V. H. Blackman, professor of plant physiology and pathology at the Imperial College of Science and Technology; Dr. William Bulloch, professor of bacteriology in the University of London; Mr. D. L. Chapman, fellow and tutor of Jesus College, Oxford; Prof. W. E. Dalby, professor of civil and mechanical engineering at the Imperial College of Science and Technology; Dr. T. R. Elliott, lecturer in practical medicine at University College Hospital Medical School; Prof. J. C. Fields, professor of mathematics in Toronto University; Dr. J. S. Flett, assistant director of the Geological Survey of Scotland; Prof. J. P. Hill, Jodrell professor of zoology and comparative anatomy at University College, London; Mr. A. R. Hinks, chief assistant at the Cambridge University Observatory; Prof. F. Keeble, professor of botany in University College, Reading; Prof. A. Keith, Hunterian professor of the Royal College of Surgeons; Dr. K. Lucas, lecturer in natural sciences, Trinity College, Cambridge; Prof. O. W. Richardson, professor of physics in Princeton University; Dr. W. Rosenhain, superintendent of the metallurgical department of the

National Physical Laboratory; Mr. G. W. Walker, formerly superintendent of the Eskdalemuir Observatory.

The Secretary of State for India in Council notifies that one appointment to the Indian Geological Survey Department will be made in July next. A further vacancy is expected to occur in the year 1914.

The Rome correspondent of *The Times* states that the Italian Geographical Society proposes to give a gold medal to Capt. Scott's family and two silver medals respectively to the families of Dr. Wilson and Capt. Oates.

The death is announced, in his eighty-fifth year, of Dr. S. A. Lattimore, professor of chemistry at the University of Rochester, N.Y., from 1867 to 1908. As a young man he spent ten years as a classical tutor and then professor of Greek at his *alma mater*, a university in Indiana. Having then decided to adopt a scientific career, he became professor of chemistry at Genesee College, where he served for seven years before his appointment at Rochester.

The death is announced, at the age of ninety-one, of Major-General Henry Clerk, R.A., F.R.S. General Clerk was elected a fellow of the Royal Society so long ago as 1848, and he served on the council in the years 1878–80. He was the author of papers on meteorological and magnetic observations made in a voyage to the Antarctic circle, and also of papers on the strength of timber, friction, and the flow of liquids through small orifices.

For the meeting of the British Association which will take place in Birmingham on September 10–17 next, the following sectional presidents have been appointed:—A (Mathematics and Physics), Dr. H. F. Baker, F.R.S.; B (Chemistry), Prof. W. P. Wynne, F.R.S.; C (Geology), Prof. E. J. Garwood; D (Zoology), Dr. H. F. Gadow, F.R.S.; E (Geography), Prof. H. N. Dickson; F (Economics), Rev. P. H. Wicksteed; G (Engineering), Mr. J. A. F. Aspinall; H (Anthropology), Sir Richard Temple, Bart.; I (Physiology), Prof. F. Gowland Hopkins, F.R.S.; K (Botany), Miss Ethel Sargant; L (Education), Principal E. H. Griffiths, F.R.S.; M (Agriculture), Prof. T. B. Wood.

Mr. R. J. Balston, of Maidstone, has presented to the British Museum (Natural History) his well-known collection of humming-birds. The birds are mounted and arranged in forty-nine cases, each of which contains a group of two or more species. The total number of specimens in the collection is stated in Mr. Balston's MS. to be 3315, representing 162 genera and 480 species. Of these, 2674 are skins, and 199 nests, some of the latter containing eggs. As soon as arrangements are made for its reception the series will be placed on exhibition in one of the corridors on the first floor of the zoological department. This collection and the Gould collection will render the exhibited series of humming-birds one of the finest, if not actually the finest, in the world.

The thirty-fifth annual general meeting of the Institute of Chemistry was held on Monday, March 3. Prof. R. Meldola, F.R.S., occupied the chair, and in the course of his presidential address he remarked that the applications of chemistry in every field of human activity have been steadily increasing, and the importance of professional chemists to the public welfare is becoming more and more recognised. Professional chemists have not secured that full measure of public recognition to which they are entitled, but in this country all scientific affairs move but slowly. The consolidation and the elevation of the profession and the maintenance of the status of the chemical practitioner will become more and more determined in the future by the standard of efficiency and of conduct set up by the fellows and associates. Until the whole level of public appreciation of the value of this profession is raised, the country is destined to lose the services of that highest type of cultured and trained chemist of which other nations are more wisely availing themselves, to our detriment and their advantage.

The following are among the lecture arrangements at the Royal Institution, after Easter:—Dr. A. S. Woodward, two lectures on recent discoveries of early man. Prof. W. Bateson, two lectures on the heredity of sex and some cognate problems. Prof. W. Stirling, three lectures on recent physiological inquiries. Prof. T. B. Wood, three lectures on recent advances in the production and utilisation of wheat in England. Dr. E. Frankland Armstrong, two lectures on (1) the bridge into life; (2) colour in flowers. Prof. J. Garstang, three lectures on the progress of Hittite studies. Prof. W. J. Pope, three lectures on recent chemical advances. Mr. H. A. Humphrey, two lectures on Humphrey internal-combustion pumps. Prof. E. Rutherford, three lectures on radio-activity. The Friday evening meetings will be resumed on April 4, when Mr. J. J. Dobbie will deliver a discourse on the spectroscope in organic chemistry. Succeeding discourses will probably be given by Mr. C. J. P. Cave, Dr. T. M. Lowry, Prof. J. Garstang, and Mr. H. G. Plimmer.

As has been pointed out already in these columns, March 19 will be the centenary of the birth of David Livingstone. The event is being and will be commemorated in a variety of ways. On February 27 the University and town of Cambridge held a meeting at the Senate House, when speeches on Livingstone's work were delivered. Livingstone College, Leyton, E., has published, as a souvenir of the centenary, an illustrated brochure, entitled "Memorials of David Livingstone"; it contains two portraits of the explorer in colour and other pictures and extracts connected with his work. Livingstone College was founded in the year 1893, in order to give instruction to foreign missionaries in the elements of medicine and surgery, and constitutes a permanent memorial to Dr. Livingstone in the neighbourhood of London. It is now appealing for a sum of 10,000*l.* in order to meet various needs, one of which is to clear off a mortgage of 3500*l.*; 1500*l.* is needed for making certain improvements, whilst it is desired to raise 5000*l.* as the nucleus of an endowment.

An eighteenth-century picture, which is said to be a portrait of Gilbert White of Selborne, has lately come to light. Referring to this discovery, Mr. Wilfred Mark Webb remarked, at a meeting of the Selborne Society on March 3, that it was believed that no portrait of Gilbert White existed or had ever been painted. There was, he said, a reason for believing this, in view of the fact that Gilbert White was marked with smallpox, and would probably therefore not wish his appearance to be recorded. Still, the picture, which had been found in the Caledonian Market, and had come into the possession of a relative of one of the members of the society, showed internal evidence suggesting its possible authenticity. The stretcher, canvas, and frame indicated the date, about 1770, when Gilbert White was fifty years of age, and the portrait fitted that age. It also had a family likeness to the portraits of John White and Thomas White. There was a tablet on the picture stating it to be a portrait of Gilbert White, but this had been added when the painting was twenty years old. It was intended if possible to trace the history of the picture, but this would be difficult, though it had once come into a sale-room in London and had been withdrawn. Mr. Webb preferred to await investigation before expressing an opinion.

In the course of a lecture on heredity in feeble-mindedness, delivered at the Galton Laboratory, University College, London, on March 4, Dr. David Heron showed a long series of pedigrees to illustrate various phases of mental defect, and said that there can be no doubt that it is a hereditary character. When, however, attempts are made to discover precise laws of inheritance, many difficulties are encountered, due to the fact that the term "mental defect" covers a multitude of conditions, each of which exists in an almost infinite number of grades of severity. Dr. Heron severely criticised some recent attempts to apply Mendelism to such cases, and showed that the evidence cited told strongly against the theory. What is specially required at the present time is more information. Special efforts ought to be made to follow up the children who are passing through the special schools for the mentally defective, and also to trace back the school histories of those who are now mentally defective criminals and paupers. Much yet remains to be discovered regarding the inheritance of mental defect, but on the basis of our present knowledge it may be asserted that a substantial reduction in the numbers of the mentally defective could be obtained by cutting off the supply at the source—by preventing the feeble-minded from reproducing their kind.

February was generally mild and dry, the rainfall in parts of England being less than one-half of the average. At Greenwich the mean temperature for the month was 41°, which is nearly 2° above the average, but is 2° colder than in February last year. There were during the month ten nights with frost in the shade, whilst on the grass open to the sky there were twenty-one frosts at Greenwich, and on the three consecutive nights from February 22 to 24, the exposed thermometer fell below 20°. The mean of the highest day readings was 47°, and the mean of the lowest night shade readings 35°. The duration of bright sunshine at Greenwich was fifty-eight hours, which is five hours more than the average for the last thirty years. The aggregate rainfall for the month was 0·80 in., which is 0·69 in. less than the average of the last sixty years, and at Kew Observatory the total rainfall was only 0·73 in., which is 0·86 in. less than the normal, and only 0·09 in. of rain fell in the last nineteen days of the month. At Greenwich the mean temperature for the three winter months was 42·5°, which is the same as the mean for the winter of 1911–12, but warmer than in any of the eight previous winters. The rainfall for the winter was about an inch in excess of the average, and February was the only dry month of the three.

The alpine flora of Japan is to be made the object of special investigation by the Tokyo College of Science, which is establishing a large botanical garden for the purpose at Nikko, situated in a region of high mountains. The Tokyo *Asahi* of January 24 devotes considerable space to an account of the new enterprise, which is intended as a complement to the two gardens, representing the temperate zone and the tropics respectively, laid out by the college some years ago elsewhere in Japan. The site for the new garden was acquired some four or five years ago, and the necessary adaptations and arrangements are expected to be completed early in the summer of the present year. The buildings erected in the enclosure comprise a laboratory, a residential building for students, experimental greenhouses, &c. The garden is to be divided into eighteen sections for the separate cultivation of all varieties of mountainous flora, ranging from trees and shrubs to ground-plants and lichens, and including foreign as well as local growths. Dr. H. Komatsu has been placed in charge of the new station, to which the large collection of alpine species already acquired by the college, but hitherto restricted through lack of accommodation, will be transferred in due course.

By the death of Mr. George Harold Drew at the age of thirty, which occurred suddenly at Plymouth on January 30, a worker of great promise has been lost to science. Intending in the first instance to qualify for the medical profession, Mr. Drew studied for this purpose at Cambridge, where he was a scholar of Christ's College, and subsequently at St. Mary's Hospital, London. He, however, never completed his medical course, and devoted himself to biological and pathological research, in which he displayed exceptional aptitude. After working for a short time at the Port Erin Laboratory, he settled at Plymouth, where, at the Marine Biological Laboratory, the greater part of his research work was done. For three years he held a Beit memorial fellowship, and he was last summer appointed John Lucas Walker research student in the University of Cambridge. He made two journeys to the United States and the West Indies for the purpose of carrying out researches in connection with the Carnegie Institution. On the purely scientific side, Mr. Drew's best work was on the development of Lamminaria and on the physiological action of marine bacteria, more particularly on denitrifying bacteria and their power of precipitating calcium carbonate. His pathological work was all undertaken with reference to the problem of cancer. He commenced by a study of the effect of transplanting tissues in invertebrates, and subsequently extended his researches to fishes, where he investigated the effect of repeated stimulation of the tissue by chemical reagents. During the short time he held the John Lucas Walker studentship he was engaged, with much success, in the culture of tissues from the frog and the dogfish in plasma outside the body of the animal.

A paper read recently before the Royal Statistical Society by Prof. E. C. K. Gonner, on the population of England in the eighteenth century, was of interest both historically and geographically. In the first part an analysis, in considerable detail, was furnished of the sources available for estimating the population before the "unfortunate superstition which delayed the taking of a census" was removed from the public mind, and of the controversy which occupied the pens of contemporary investigators. By means which he fully set forth, the author then arrived at conclusions which justified him in presenting comparative maps of the density of population in England in 1700, 1750, and 1801, which, while greatly generalised and based only on county areas, show several features of the highest interest. To take one case, the early establishment of a dense population in Lancashire, contrasted with its later establishment in the midland industrial area, and still later in the West Riding of Yorkshire, forms a series of facts which clearly emerges on the maps. Throughout the period there is visible the tendency of the present industrial areas to take their places above the purely agricultural areas in the list of relative density of population, although the population of the agricultural areas by no means declined. The results so accurately parallel the history of these areas at the period that the author's conclusions and his use of authorities are clearly justified.

No. 17 of the sixtieth volume of Smithsonian Miscellaneous Collections is devoted to notes by Mr. A. H. Clark on the American species of Peripatus, with a list of the known New World representatives of the group.

The Agricultural Department of India has issued a further instalment, in its Memoirs, of the life-histories of Indian insects; this contribution, which is by Mr. G. R. Dutt, dealing with parasitic and other Hymenoptera. In the case of some of the Mutillids, or "velvet ants," it has not yet been ascertained how many species they may affect parasitically, and as this may have an important economic bearing inquiries are to be set on foot with the object of filling this gap in our knowledge.

In an interesting and fully illustrated report of an expedition to Arctic America, published in the January issue of *The American Museum Journal*, Mr. R. M. Anderson states that the musk-ox was exterminated by Eskimo in the neighbourhood of Franklin Bay about fourteen years ago, and that the species is also practically killed off in the district around the east end of Great Bear Lake. The barren-ground caribou and the white sheep have likewise suffered severely at the hands of natives armed with modern weapons, although small numbers of the latter are still to be found near the sources of every river from the Colville to the Mackenzie, which probably formed the limit of its range.

Messrs. J. G. O'Donoghue and P. R. H. St. John have published in *The Victorian Naturalist* (January, 1913) some notes on the vegetation and bird-life of the Brisbane Range, in continuation of their earlier work on the natural history of this little-known Australian locality. The prevalence of the gum-tree saw-fly in this area may be judged from their mention of a sapling of *Eucalyptus rostrata* which actually drooped with the burden of five large masses of the larvæ of this insect. Among other items of these interesting notes, mention may be made of the extraordinary activity of small red ants in the transport of the seeds of acacias, evidently for the sake of the oily appendage (caruncle), which the ants bite from the seed, leaving the latter in great masses outside the nest. Brief references are made to the various types of vegetation associated with different soils and physiographic aspects, but it is greatly to be hoped that Victorian botanists will make a detailed ecological investigation of what appears to be an area of unusual interest from this point of view.

Prof. F. W. Oliver has contributed to *The Gardeners' Chronicle* (No. 1364, February 15) an extremely interesting account of the new nature reserve at Blakeney, Norfolk. The extensive area of waste maritime lands known as Blakeney Point, which has been presented to the National Trust, is to be preserved as a place for the study of wild nature, its acquisition having been made primarily on scientific grounds rather than on account of its scenic or historic interest, though it is fully entitled to rank as a place of great natural beauty. As Prof. Oliver has shown in his recent article in *The New Phytologist*, Blakeney Point shows to perfection the operation of the sorting mechanism by which new ground is built up from the spoils won by the sea from the land, and brought back by an orderly process in the form of shingle, sand, and mud, and also the colonisation of this new ground by plants appropriate to its kind. The distinctive features at Blakeney are the profusion in which developmental stages of all the maritime plant-communities abound, and the rapidity with which change in each sort of terrain is being accomplished. Apart from its ecological interest, the Point is famous as a breeding ground for wild seafowl, and as a place of call for winter migrants, while in many and various respects the fauna generally is full of interest, especially with reference to the important and sometimes surprising relation of the insects and the rabbits to the plant population.

The liability to drought in India as compared with that in other countries is the subject of an interesting paper by Dr. G. T. Walker in the Memoirs of the Indian Meteorological Department (vol. xxi., part v.). The paper is a preliminary attempt to deal with the matter from an examination of the annual records, owing to want of details for some countries. A tabular statement gives for a number of stations for which long series of observations were available the normal rainfall and the percentage of years with deficiency (1) between 30 and 45 per cent., (2) between 45 and 60 per cent., and (3) more than 60 per cent. In India places on the coast usually fare better than those in the interior; but burning sun and hot-dry winds during a long break in the rains do much more harm than in some other countries. In the United States, *e.g.* a deficiency of rain produces nothing like the damage that it does in India, while in Europe the liability to failure in the crops is not in the least comparable with that of India. In South America, Brazil and the Argentine Republic show nothing worse than a few cases of deficiency between 30 and 45 per cent., but in Chile, Santiago shows a considerable number of cases of deficiency in the three classes above mentioned; in some parts of Chile there may be a year without any rain whatever.

THE January number of the American journal *Good Lighting* contains an article by Prof. Gotch, of Oxford, which gives a valuable summary of our present knowledge of the properties of the eye when used for detecting and observing distant coloured lights, such as are seen at sea. The normal eye under such conditions recognises a red light as red over an area of the retina the radius of which is three or four times that over which a green light is recognised as green. Outside this area the red light is not seen at all, while the green light outside its area of recognition is seen as a bright white light. In view of these facts, Prof. Gotch suggests that in the absence of binoculars, on which in practice the recognition of the colour of a distant light depends, it should be noted whether the light, apart from its colour, is seen better by oblique than by direct vision; if so, it is a green or white light. If it is seen better by direct than by oblique vision it is red.

RED BOOK No. 176 of the British Fire Prevention Committee deals with tests made on a new celluloid substitute, intended to reduce the risks of fire from the use of kinematograph films. The material was "Cellit," which is an acetyl-cellulose, manufactured by the Bayer Company, Ltd., and resembles celluloid in all respects except that it is far less inflammable and appears to be practically free from the dangers which attend the use of celluloid. As the result of stringent tests to which it was subjected, the material was awarded the committee's certificate of "non-flaming." A copy of the report can be obtained from the secretary of the committee, 8 Waterloo Place, Pall Mall, S.W.

The Engineer for February 28 contains an account of an automatic electric light plant manufactured by Messrs. R. A. Lister and Co., Ltd., of Dursley, Gloucestershire. This plant is intended for private house installations, and consists of a petrol engine, dynamo, automatic starting switch, and water tank, the whole being mounted on two cross girders providing facility for setting down and removal. A small battery is supplied, of capacity very much below that of our ordinary private electric lighting plant. When the battery is charged and no lights on, the engine is at rest. If lights are switched on in number below that capable of being dealt with by the normal discharge of the battery, the engine remains at rest until the battery voltage drops to a certain value. On this voltage being reached, current is automatically sent through the dynamo, and runs it as a motor, thus starting the engine, an operation facilitated by the exhaust valve being automatically held open. When the battery is sufficiently charged, the engine stops again. The engine will also start and keep running if the demand is higher than that which can be dealt with by the battery alone. Exhaustage of the battery by reason of failure of the engine to start when required is prevented by a time-limit circuit-breaker, which allows starting current to pass through the dynamo for a limited period only. The whole arrangement seems likely to minimise the troubles which occur in small lighting sets owing to improper handling of the batteries.

THE issue for 1912 of the "Year-Book of the Scientific and Learned Societies of Great Britain and Ireland" has now been published by Messrs. Charles Griffin and Co., Ltd. It is described on the title-page as a record, compiled from official sources, of the work done in science, literature, and art during the session 1911–12, and in consequence its appearance is a little belated, and the information provided about some associations rather behind the times. But the present is the twenty-ninth issue of a work of reference which has proved its utility to workers in science and literature; its welcome would be even greater if it could be published in October, when the academic and scientific sessions begin.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A COMET 1912*d*.—From *The Times* of February 26, we learn that a faint comet was discovered by Mr. B. Lowe, at Laura, South Australia, on December 31, 1912. According to the report by Mr. Dodwell, director of the Adelaide Observatory, the object was visible in a small telescope, and was seen to have a short tail; its position on December 30, at 5.30 p.m. (G.M.T.), was about 4° south of Spica, and it was travelling southwards so rapidly that the position on January 5 was about $\alpha = 14$h. 30m., $\delta = 29° 50'$ S. An approximate orbit gives February 3 as the time of perihelion passage, when the comet was probably some sixty million miles from the sun, and indicates that the least distance from the earth occurred about the time the object was discovered, and was about twenty-five million miles. Mr. Dodwell also states that Mr. Lowe anticipated Mr. Gale in the discovery of comet 1910*a*, but did not notify the fact until later.

AN INTERESTING OCCULTATION.—On March 13 an interesting occultation will be provided by the moon passing in front of the Pleiades. As new moon occurs on March 8, our satellite will, at the time of the occultation, present a fairly thin crescent, and the several stars of the group will disappear at various points on the dark limb, to reappear at the bright limb. The first bright star to disappear will be Electra (mag. = 3·8), which will enter near the southern horn at 10h. 1m. p.m. Then will follow Merope (mag. = 4·3), hidden from 10h. 7m. to 11h. 2m.; Alcyone (η Tauri, mag. = 3·1), from 10h. 47m. to 11h. 25m.; Atlas (mag. = 3·8), from 11h. 20m. to 12h. 9m. (midnight); and Pleione (mag. = 5·2), from 11h. 26m. to 12h. 7m. Asterope, Taygeta, and Maia will not be occulted, and it will probably surprise many people to observe how much larger the Pleiades group apparently is than the moon; about one degree, or two lunar diameters, separate Atlas from Taygeta or Electra. Occultations of the Pleiades will also occur, in daylight in Great Britain, on July 28 and October 18.

Publications of the Vienna Observatory.—We have received vols. xxi. and xxii. of the *Annalen der K.K. Universitäts-Sternwarte in Wien*, edited by Prof. Hepperger. The former contains the results secured with the 27-in. Grubb refractor during the period 1903–06, and deals with a great number of observations of planets, comets, and nebulæ. The second volume is divided into two parts, the first dealing with planet and comet observations made with the 6-in. Fraunhofer refractor by Dr. J. Holetschek during 1903–10, and the second, by Dr. J. Rheden, giving an account of the observing station, and the observations made, at Sonnwendstein, from November, 1909, to 1910. The Sonnwendstein station is at an altitude of 1523 m., and the daily notes concerning the atmospheric conditions and their influence on the observations are of special interest.

Astronomical Year-Books.—"The Observer's Handbook for 1913," published by the Royal Astronomical Society of Canada, is a very useful, though small, volume, which contains a great deal of information set out in a form most useful to the amateur astronomer. In addition to various ephemerides it gives the astronomical phenomena for each month, and a detailed summary of special stellar objects which are available for observation month by month. It also contains four very useful and clear star charts, covering the whole sky, and a brief account of "Recent Progress in Astronomy," written by Mr. W. E. Harper.

The *Annuario* of the National Observatory of Brazil contains the usual full complement of ephemerides and astronomical and physical tables. An interesting map is also included, showing the central lines of all the total eclipses of the sun visible in Brazil between the years 1912 and 2162, as prepared by Prof. D. Todd.

THE EUGENICS EDUCATION CONFERENCE.

THIS conference was organised by the Eugenics Education Society for the purpose of opening up discussion on the possibility and advisability of infusing the eugenic ideal into the minds of school children and on the best methods for so doing. More than 400 headmasters and headmistresses or their representatives assembled in the large hall of London University on March 1 to take part in the debate, and it is in some ways to be regretted that with so large and expert an audience the subject discussed should have been rather sexual hygiene than eugenics. The relation between the two subjects was so clearly and admirably pointed out by Major Darwin in his presidential address on the eugenic ideal, that it is difficult to understand why so many subsequent speakers should have appeared to regard them as identical.

The discussion at any rate had the merit of showing how much the minds of the more earnest educationists are exercised in the question of instruction in sexual hygiene. The objections to its introduction into schools fall into three classes. In the first place it is maintained that the growing mind should be kept free from thoughts on sexual matters; to which it may be answered that practical experience shows this to be impossible. In private schools, attended by boys of nine to fourteen years of age, such subjects are certainly discussed, and it cannot be supposed that the pupils of corresponding ages in public elementary schools, with their ampler experience of the seamy side of life, are behindhand in this respect.

Secondly, there are many who say that it is practically impossible to introduce the subject in a fitting manner. These were answered by Mr. Badley, headmaster of Bedales, the well-known coeducational school, and by Miss Bonwick, headmistress of the Enfield Road Primary School, who each described their own methods. Miss Bonwick's speech is worthy of special mention, as her eloquence and enthusiasm made a marked impression on the audience. Prof. J. Arthur Thomson also dealt with this aspect of the subject clearly and wisely.

Thirdly, it is said that instruction as to sex should be given by the parents, to which it may be answered that in most cases the parents are quite unfit to give it.

Major Darwin, speaking in the name of the Eugenics Education Society, did not attempt to teach the teachers on these matters, but urged that in all institutions where sex hygiene is taught it should be taught in connection with the eugenic ideal. His address, together with those of the headmaster of Eton, the Principal of Bedford College, Prof. J. Arthur Thomson, and Mr. Badley, and the reports of other speeches, will be published in the April number of *The Eugenics Review*, and have therefore scarcely been touched on here. E. H. J. S.

NAPIER TERCENTENARY CELEBRATION.

IN the year 1614 John Napier, Baron of Merchiston, published his "Mirifici Logarithmorum Canonis Descriptio," a small quarto volume, the influence of which upon the development of mathematics, especially as an instrument of calculation, cannot be overestimated. The council of the Royal Society of Edinburgh, mindful of the greatness of the boon conferred on science by Napier's invention, convened a committee representative of some twenty societies, corporations, and institutions to discuss the proposal to hold a celebration in memory of the event. The universities and colleges of Scotland, the Faculty of Actuaries, the Edinburgh Mathematical Society, the Institute of Bankers, and other like bodies, also the Royal Society of London and the Royal Astronomical Society, were represented by delegates to the first meeting of the committee, which was held in the Royal Society Rooms, 22 George Street, Edinburgh, on Saturday, February 22. Mr. J. R. Findlay, one of the representatives of the Edinburgh Merchant Company, was voted to the chair.

Dr. Knott (general secretary, Royal Society of Edinburgh) and Dr. A. E. Sprague (Faculty of Actuaries) were appointed honorary secretaries in connection with the celebration, and Mr. Adam Tait, Royal Bank of Scotland, was appointed honorary treasurer. With these as officials, an executive committee was nominated to carry into effect the following resolutions:—

That a congress be held in the summer of 1914, to be opened by a public reception and an address by an eminent man on some aspect of Napier's life and work; that, in response to an invitation from the directors of Merchiston Castle School, a garden-party be held in the grounds of Merchiston Castle; that papers be read on methods of calculation and of mathematical teaching; that exhibits be made of all kinds of calculating machines, of logarithmic and other mathematical books which are necessary for calculation, and of objects of historic interest associated with the name of Napier; that eminent mathematicians be invited from foreign countries to take part in the celebration; that a memorial volume be published containing the more important of the addresses and communications; that, to meet preliminary expenses, a donation list be opened, to which societies and individuals may contribute; that those interested in the proposal be asked to become founder members, the subscription being £2; and that the ordinary subscription be kept as low as possible.

The executive committee was given powers to add to its number and to appoint subcommittees to take charge of the special departments of work indicated above, and of any other lines of development which might occur to them.

THE METHOD OF "SHOCK-EXCITATION" IN WIRELESS TELEGRAPHY.

IN *Die Naturwissenschaften* of January 24 there appears an excellent short descriptive article on the principles and the advantages of the "shock-excitation" method of generating electrical oscillations, written by Dr. G. Eichhorn. The method of shock-excitation is used in wireless telegraphy on the large scale by the Gesellschaft für drahtlose Telegraphie ("Telefunken" system), and was first properly investigated and explained by Max Wien. Its essence consists in using a very short-lived oscillatory discharge in a primary circuit, to excite oscillations in an antenna arranged as a secondary circuit, the life of the primary oscillation being, in the ideal arrangement, just so long as to admit of the transference from primary to secondary of the maximum fraction of the initial energy—that is, the energy stored on the condenser in the primary circuit just before the beginning of its discharge. The points especially discussed are the conditions governing, and the means of realising, this ideal arrangement.

Dr. Eichhorn starts with the fact that in a pair of coupled circuits the phenomenon known as "beating" takes place, and that in the time of a beat the oscillatory energy passes from the primary to the secondary and back again. The time of a beat depends on the closeness of the coupling, being shorter with closer coupling. But in the quenched spark method of exciting oscillations the stoppage of the primary oscillation is effected by cooling the spark—that is to say, by de-ionisation of the spark-gap—and the critical moment for the stoppage is the first occasion on which the whole energy passes from the primary to the secondary, namely the moment of the middle of the first beat in the secondary circuit. Thus the better the quenching the closer can the coupling be made. The author shows that the primary must be tuned to the secondary the more exactly, the less effective the quenching is. Among the advantages claimed for the method that of economy is placed first, and a comparison of published researches shows that this method of shock-excitation may have an efficiency of 75 per cent. as against the 25 per cent. of the ordinary spark or the 10 per cent. of the Poulsen arc method.

A SUPERANNUATION SCHEME FOR ENGLISH UNIVERSITY TEACHERS.

THE advisory committee on the distribution of Exchequer grants to universities and university colleges in England has issued its second report (Cd. 6617). In the first report it was recommended that a certain proportion of the grant of 149,000*l.* available for distribution among the English colleges should be reserved pending consideration of a superannuation scheme, and should be regarded as applicable to the institution of such a scheme and to other purposes.

Several conferences have been held between a subcommittee of the advisory committee and representatives of the universities and colleges concerned, existing schemes have been examined, the possibility of a federated scheme has been considered, and the present report gives the governing principles which the committee suggests should underlie each scheme.

I. *Scope.*—(*a*) The new scheme should come into force on October 1, 1913, when—

(1) It should be compulsory on all new entrants in receipt of a salary of not less than 300*l.* a year.

(2) All new entrants in receipt of less than 300*l.*, but not less than 200*l.* a year, should be entitled to join the scheme.

(3) Any new entrant in receipt of less than 200*l.*, but not less than 160*l.* a year, should, with the consent of the governing body, be allowed to join the scheme.

(4) Any member of the existing staff who satisfies the salary conditions under (1)–(3) above should, with the consent of the governing body, be allowed to join the new scheme under such provisions as to his interest (if any) in any existing scheme of superannuation as may be approved by the governing body.

(*b*) Provided always that no member of the staff should have a claim for inclusion in the scheme who does not, in the opinion of the governing body, devote his main time to his duties as a member of the teaching or administrative staff.

II. *Contributions.*—(*a*) The total contributions in all cases should be 10 per cent. of the salary, except that in the case of salaries above 1000*l.* a year no contributions should be made in respect of the excess above 1000*l.*

(*b*) The normal contributions should be 5 per cent. of salary by the beneficiary and 5 per cent. by the institution, but if the governing body desire, it should be able to increase its proportion of the total 10 per cent. and diminish correspondingly the proportion payable by the beneficiary.

(*c*) If a person is a member of the staff of two or more institutions both within the federated system, the combined salary should be taken into account and the institutions should contribute *pro rata*.

III. *Benefits.*—(*a*) The benefit should include an annuity on reaching the age at which the benefit matures, or, so far as the governing body thinks desirable in each case, an equivalent cash payment. The beneficiary should, however, have the option of choosing a form of provision which secures in addition a benefit in the event of death.

(*b*) The age at which the policies mature should be fixed at sixty.

IV. *Means of Securing the Benefit.*—Every beneficiary should have the option of securing his benefit by means of an insurance policy. The governing body should have the power, however, if it thinks desirable, in individual cases, and if the beneficiary concurs, to accumulate the contributions by separate investment in trustee securities on behalf of the beneficiary. These separate investments may be in addition to, or in substitution for, an insurance policy. Thus the various types of options would be as follows:—

(a) A deferred annuity or equivalent cash payment with a considerable benefit in the event of death while in service—to be obtained from insurance companies by means of "endowment assurance" policies of varied types.

(b) A deferred annuity or equivalent cash payment with return of accumulated contributions in the event of death while in service—to be obtained from insurance companies by means of a "sinking fund" policy (or, if necessary, in individual cases by separate investment as above).

(c) A deferred annuity without any return of premiums in the event of death while in service—to be obtained from insurance companies.

V. *Ownership of Benefit.*—(a) The governing body should hold the policy or other equivalent accrued benefit in trust for the beneficiary so long as he remains at the institution, and the beneficiary should execute some form of legal document which would enable the governing body so to do.

(b) On the transfer of a beneficiary from one institution to another within the federated system, the whole of the accrued benefit should be transferred to the second institution.

(c) In the event of a beneficiary leaving an institution before the retiring age, for any reason other than that indicated in (b) above, he should have the right to the whole of the accrued benefit, but the governing body should have the right to determine how the accrued benefit should be given.

The advisory committee states that universities and colleges would be prepared to inaugurate a superannuation system on the basis of the foregoing principles, but, as in most cases increased outlay will thereby be involved ultimately, it is unreasonable to expect them to adopt the proposals until they know the amount of the assistance they may expect to receive by way of grant. The committee therefore makes recommendations for a further distribution of the money held in reserve.

Grants are made to thirteen universities and colleges varying from 1000*l.* each in the case of the Universities of Liverpool and Manchester, to 300*l.* each in the case of Bedford College, London, London School of Economics, East London College, and Reading University College. The colleges at Nottingham and Southampton do not receive additional grants.

The additional grants now recommended, together with those announced in March, 1912, dispose of a yearly sum of 148,000*l.* out of the 149,000*l.* available. The committee recommends that the annual balance of 1000*l.*, together with the balance of 2550*l.* from previous Exchequer grants, should be held over to meet contingencies.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The Lord Mayor of Birmingham has opened a fund for the establishment of a memorial to the late Vice-Chancellor, Alderman C. G. Beale, whose services to the city were such as to demand a permanent monument to his name. It is proposed to devote the money subscribed to two objects, both of which would certainly have had the approval of the late Vice-Chancellor, viz. the endowment of a chair in the University (to be called the Beale chair), and the equipment of one of the rooms in the new Natural History Museum of the city with a collection of British birds and their nests in natural surroundings. Already promises to the amount of 9000*l.* have been received, including one donation of 5000*l.*, earmarked for the Beale chair, from that most generous friend of the University Sir Charles Holcroft.

CAMBRIDGE.—The General Board of Studies will proceed shortly to appoint a University lecturer in the philosophy of religion. The appointment is for three years from October 1, 1913. The annual stipend is 100*l.* Candidates are requested to send their applications to the Vice-Chancellor, with testimonials, if they think fit, on or before Friday, April 11.

Mr. A. Harker has been nominated to represent the University at the twelfth International Geological Congress to be held in Canada in August next.

OXFORD.—Sir William Mitchell Ramsay will deliver the Romanes lecture at the Sheldonian Theatre on Thursday, May 8, at 3 p.m. The subject of the lecture is "The Imperial Peace."

Mr. R. B. Bourdillon, lecturer in chemistry at Balliol College, has been elected to a fellowship in chemistry on the teaching staff of University College.

The degree of M.A. has been conferred by a decree of Convocation on Prof. W. H. Perkin, F.R.S., fellow of Magdalen College, the recently elected Waynflete professor of chemistry.

At the same Convocation, the statute altering the constitution of Congregation by abolishing the qualification of residence, and making other changes with the view of confining the membership to the "teaching and administrative elements in the University and the colleges," passed its final stage by 77 votes to 49.

In the Educational Supplement of *The Times* of March 4 an important letter appears from Prof. Poulton, F.R.S., pointing out that the extension of the scientific departments of the University was one of the principal objects had in view by the promoters of the original purchase for the University of the ground known as the Parks. The letter directs attention to a scheme which was devised some years ago, though not accepted by the University, in accordance with which a space of ten or eleven acres adjoining the museum at the south-west angle of the Parks would be definitely allocated to the purposes of the scientific departments at present existing or to be established in future. This would leave six-sevenths of the present open space untouched and unthreatened by building.

SHEFFIELD.—Dr. Sophia M. V. Witts has been appointed to the newly instituted post of lady tutor in anatomy.

MR. AUGUSTINE HENRY, reader in forestry, University of Cambridge, has been appointed to the professorship of forestry recently established in the Royal College of Science for Ireland.

DR. A. R. FORSYTH, F.R.S., formerly Sadlerian professor of pure mathematics in the University of Cambridge, has been appointed chief professor of mathematics at the Imperial College of Science and Technology, South Kensington.

As announced already, a course of four public lectures on the theory of the solid state, will be delivered at University College (University of London), by Prof. W. Nernst, director of the Institute of Physical Chemistry in the University of Berlin, at 6 p.m. to-day, March 6, and at 5 p.m. on March 7, 10, and 11. The chairman at the first lecture will be Sir William Ramsay, K.C.B.

AT the annual meeting of the court of governors of the Middlesex Hospital, on February 27, Prince Alexander of Teck, in moving the adoption of the report, announced an anonymous gift of about

10,000*l*. The object of the gift is to defray the cost of erecting a new pathological block and institute of hygiene. The scheme is one which the governors have been anxious to carry out for some time, as the present accommodation is wholly inadequate, but lack of funds has hitherto proved an insurmountable barrier to progress in this direction. The plans have been prepared, and it is hoped the work will be started almost immediately.

At the meeting of the executive committee of the Carnegie Foundation for the Advancement of Teaching, held on February 11, it was announced that Mr. Andrew Carnegie had given an additional 250,000*l*. to the foundation. The gift is in the form of 4 per cent. bonds and the income is to be set aside for special investigation relative to the purposes of the original foundation of pensioning college professors. The money is to be devoted to the endowment of a division of educational inquiry and makes permanent provision for studies hitherto conducted by the foundation out of its general fund. It is the plan of the trustees to proceed with the new endowment to make other studies similar to those already published concerning medical education and in particular to study legal education in its relation to the supply of lawyers and the cost of legal process.

An appeal on behalf of the British and Foreign Blind Association, 206 Great Portland Street, London, W., signed by four blind members of the executive council, including Mr. H. M. Taylor, F.R.S., is being circulated. One of the chief objects of the association is the maintenance of a printing press of works in embossed type; and properly to carry out this and other good works the council finds that extended premises are necessary. The sum of 10,000*l*. has been expended in carrying out part of the work entailed by the scheme for a new building, and the completion of the work, including adequate equipment, necessitates the raising of a further sum of 29,000*l*. The council is anxious that the invested funds of the association, producing an annual income of some 400*l*., should not be touched. To maintain the work on an enlarged scale an increase of 1000*l*. in annual subscriptions is needed. Donations or subscriptions should be sent to the honorary treasurer, Mr. Douglas A. Howden, or to the secretary-general.

The report of the committee of University College, London, for the year ending last month is full of interesting particulars of the manifold activities of the institution. The total number of students during the session 1911–12 was 1679, being an increase of 79 over that of the preceding session. Of these students 403 were engaged in post-graduate study and research. In the faculty of science there were 392 students, and in engineering 174. Of the 403 post-graduate and research students, 117 were women. There were 710 registered internal students of the University of London, compared with 678 in the previous year. We notice that the sums promised and paid, together with interest on deposit and rents, for the new chemical laboratories, amounted in July last to upwards of 38,000*l*. A tender for the erection of the fabric at a cost of 39,000*l*. has been accepted, and the work is being pushed forward. A sum of about 28,000*l*. will be required to complete the laboratories, and it is earnestly hoped that the necessary amount will be speedily forthcoming, so that the completion of the scheme and the opening of the laboratories may not be delayed.

The erection of new chemical laboratories is not the only important step in progress for the development of the buildings of University College, London. The recently published report of the committee of the college gives, in addition to an account of the formal opening last December of the new Pharmacology Institute, particulars of the plans being adopted to provide a great hall for examinations and ceremonial occasions. The site of All Saints' Church, Gordon Square, the west wall of which adjoins the Carey Foster Laboratory, has been acquired at a cost of 5900*l*., which, together with legal expenses, has been provided temporarily from current income, pending the provision of the necessary sum. The Ecclesiastical Commissioners have approved the scheme for the reconstruction of the existing church building. Under this scheme the old building will be so altered as to provide a hall capable of accommodating 1100 persons. The purchase of the site, together with the expenses of reconstruction and refitting, will involve an expenditure of 10,000*l*.; it is desirable to provide an organ, in addition to the ordinary fittings at a cost of 2000*l*., making the total cost 12,000*l*.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 27.—Sir Archibald Geikie, K.C.B., president, in the chair.—F. **Soddy**: The periodic law from the point of view of recent results in radio-activity.—C. F. **Jenkin** and D. R. **Pye**: The thermal properties of carbonic acid at low temperatures. The paper describes a series of experiments made in the engineering laboratory at Oxford, undertaken with the object of checking by direct measurements the accuracy of the accepted CO_2 entropy-temperature diagram, due to Mollier, and of extending the diagram to lower temperatures, *i.e.* from $-30°$ C. to $-50°$ C.—E. **Roberts**: Re-reductions of Dover tidal observations, 1883–4, &c.—Prof. F. **Keeble**, Dr. E. F. **Armstrong**, and W. N. **Jones**: The formation of anthocyan pigments in plants. Part iv., The chromogens. The results of the experiments described in this paper lend support to the hypothesis that the anthocyan pigments of plants are produced by the oxidation of colourless chromogens. Under certain conditions a coloured flower may be caused to reverse its pigment-forming process and to reduce the pigment which it contains to a colourless state. By again changing the conditions the pigment-forming mechanism may be made to resume activity and to give rise to pigments identical in colour with those of the normal intact flower. Whether the flower forms pigment or remains colourless depends on the degree of hydration of its tissues. If water be withdrawn from the tissues oxydase activity falls off, the activity of "reducing-bodies" becomes increased—actually or relatively—pigment formation is inhibited, and the pigment in existence already is reduced to chromogen. The flower becomes colourless. If water be supplied to the decolorised tissues, oxydase resumes its activity and chromogens are oxidised to pigments.—W. N. **Jones**: The formation of the anthocyan pigments of plants. Part v., The chromogens of white flowers. This paper, which deals with the biochemistry of the pigment-forming mechanism contained in white flowers, is a continuation of the work summarised in part. iv. of the present series of communications. As shown in the latter paper, the pigments of flowers may be reduced to the state of colourless chromogens and may be re-formed by artificial means from those chromogens. In the present paper it is shown that chromogens may be obtained from some white flowers and may be caused by similar treatment to give rise to pigments.—Mabel P. **FitzGerald**: The changes in the breathing and the blood at various high altitudes. The observations described in the paper were made during the summer of 1911 on persons residing in towns, mining camps, &c., at various altitudes from 5000 to 14,000 ft. in the Colorado portion of the Rocky Mountains. The main conclusions reached are as follows:—(1) The volume of air breathed per unit mass of CO_2 produced by the body is always increased in persons acclimatised at high altitudes. The mean increase of breathing is such as to produce a fall of about 4·2 mm. (or roughly 10 per cent. of the normal for sea-level) in the partial pressure of CO_2 in the air normally present in the lung alveoli for every 100 mm. of fall in the barometric pressure. Both men and women show this fall, after allowance is made for the normal difference in the alveolar CO_2 pressure of men and women. (2) The percentage of hæmoglobin in the blood of acclimatised persons is likewise increased, the mean increase being about 10 per cent. of the normal at sea-level in men for every 100 mm. of diminution in the barometric pressure. Both men and women show this fall. (3) It may take some weeks for these changes to establish themselves fully in persons passing to a high altitude or to disappear in persons passing to sea-level.

Zoological Society, February 18.—Prof. E. A. Minchin, F.R.S., vice-president, in the chair.—H. B. **Preston**: Diagnoses of new species and varieties of agnathous mollusca from equatorial Africa. The author directed attention to the enormous field for conchological research awaiting the student of this very fruitful region, and stated that in many parts each range of hills appeared to have, to a certain extent, its own special molluscan fauna, often characterised by certain local and peculiar phases common not only to the species but also to the genera occurring in that particular locality.—W. A. **Lamborn**: Notes on the habits of certain reptiles in the Lagos district. An account was given of the habits of the lizard *Agama colonorum*, especially relating to courtship, polygamous practices, and combativeness, and of native superstitions in regard to chameleons. Observations were also recorded on a batch of eggs of a crocodile, probably *Crocodilus niloticus*, on their hatching, on the behaviour of the newly hatched young, and on the native beliefs as to the habits of the mother crocodile.—Dr. R. **Broom**: The Gorgonopsia, a suborder of the mammal-like reptiles. Descriptions of a new genus and two new species of Gorgonopsids, based on well-preserved skulls discovered by Mr. S. H. Haughton and the Rev. J. H. Whaits. The Gorgonopsia were re-established as a distinct suborder of the Therapsida, and a list of the characters distinguishing the Gorgonopsians from the Therocephalians was given.—Dr. R. **Broom**: The South African Rhynchocephaloid reptile, *Euparkeria capensis*. A detailed account of this species was given, and its affinities with allied forms discussed. The evidence at present seemed to show that Euparkeria was to be regarded as a member of an order of generalised Rhynchocephaloid reptiles, and might be taken as the type of a most important suborder of this group containing the ancestors of the Dinosaurs, the Pterodactyles, and the birds.—R. **Lydekker**: The heads of a male and female dwarf buffalo shot by Lieut. A. W. Hunt, R.N., in Southern Nigeria. The name *Bos caffer hunti* was suggested. This race agrees with the Gambian *B. c. planiceros* in that the adult bulls are darker than cows, but is of smaller size, with the orange band on the throat narrower. Mr. Lydekker also proposed the name *B. c. beddingtoni* for a mounted bull of a red dwarf buffalo from Ashanti, mainly on the ground that it is cut off from the red Congo *B. c. nanus* by the above-mentioned Nigerian race.—Dr. G. Stewardson **Brady**: Descriptions of two British Entomostraca apparently new to science. One was a Diaptomus, obtained abundantly in Loch Ness many years ago, but hitherto unnoticed; the other an Ostracod, of which one specimen only was found in brackish water in Sussex. The latter formed the type of a new genus, and possibly also a new family.

Institution of Mining and Metallurgy, February 20.—Mr. Edward Hooper, president, in the chair.—J. **Douglas**: Historical sketch of the Copper Queen Mines and Works, Arizona, U.S.A.—A. **Notman**: Geology of the Bisbee ore deposits.—C. **Legrand**: The power plant at Bisbee, Arizona; the power plant at Douglas, Arizona.—G. B. **Lee**: Reduction works at Douglas, Arizona. These five papers, dealing with different aspects of the famous Copper Queen property, are the amplification of a lecture delivered by Dr. Douglas before a special meeting of the institution in a previous session. The historical portion traces the development of the copper-producing industry in the Far West from its origin in about 1870 until the present date, incidentally showing the obligation under which mining is placed to the great railroad enterprises that have linked up the two sides of the continent. With regard to the geological surveys that have, more especially in recent years, supplemented the earlier empirical development work, Dr. Douglas points out that even in recent years the strictly exploratory work represents about one-fourth of the cost of the total mining operations, a proportion which it is hoped will be reduced in the future as the result of more accurate geological research. Mr. Notman's contribution to the quintet of papers shows that the system of geological survey has been conducted in a thorough manner, but that there are still unsolved problems with regard to many parts of the field, opening up possibilities of valuable discoveries in the sedimentary rocks of greater age and the intrusive igneous rock. The two papers dealing with the power installation at Bisbee and Douglas show that the consolidation of the various properties now comprised in the Copper Queen group has enabled a considerable improvement to be effected in this department. A feature of the reduction works is the attempt that has been made to deal with the problem of dust losses in the smoke from the converters and blast-furnaces.—R. **Davey**: Copper-smelting methods at Bogoslowsk, Perm, Russia. A special interest attaches to the works described in this paper, as they were among the earliest in the eastern hemisphere to adopt the Bessemerising of copper matte, the plant dating back to 1885. A modern plant is now in course of erection to supersede the somewhat out-of-date methods hitherto in vogue, which have accounted nevertheless for a considerable yearly production.

PARIS.

Academy of Sciences, February 24.—M. F. Guyon in the chair.—Paul **Appell**: Functional equation for the relative equilibrium of a homogeneous liquid in rotation under the Newtonian attraction of its parts.—H. Le **Chatelier** and Mlle. **Cavaignac**: The fusibility of the natural fatty bodies. From the study of the melting and solidifying points of two fats, vegetaline and stearin, it is shown that the phenomenon of change of state is strictly reversible. The exact temperature of transformation can be determined with an accuracy of 0·1° C., but the experiments require much time. There is no evidence of the existence of polymorphic bodies, the only peculiarity found being that the velocity of change of state is extremely slow.—Stuart **Menteath** and H. **Douvillé**: The Eocene deposits of Bos d'Arros.—Pierre **Duhem**: The stability of thermal equilibrium.—W. **Kilian** and Ch. **Pussenot**: A detailed analysis of the dislocations of the Eastern Briançonnais.—E. **Bompiani**: The configurations of Laplace.—Gustave **Sannia**: Some new properties of the characteristics of partial linear equations of the first order in two variables.—T. de **Donder**: The theorem of independence of Hilbert.—L. **Crussard**: The propagation and alteration of waves of shock.—Alexandre **Sée**: A new principle of longitudinal stability of aëroplanes.—Albert **Turpain**: The recording of time signals and Hertzian telegrams with the aid of a Morse apparatus. A detailed description of two types of galvanometer used, in conjunction with a system of relays, in working recording apparatus.—V. **Crémieu**: The effects of flexion at the points of attachment of the wire of a torsion balance. A continuation of a previous paper on the same subject, with suggested applications to seismographs, dynamometers, and microbalances.—E. **Briner** and A. **Kuhne**: The transformation undergone by heated calcium carbide. When calcium carbide is heated in a closed vessel at 800° to 1000° C. the only transformation it undergoes is a decomposition into its elements. There is no evidence in support of the view that a subcarbide is formed.—E. **Fouard**: Differential tonometry of solutions and the theory of Arrhenius. The results with sugar are not in accord with the current theories of solution.—H. **Colin** and A. **Sénéchal**: The oxidation of complex cobalto-organic compounds. A study of the velocity of oxidation by air of an alkaline cobalto-glycerol solution.—Marc **Bridel**: The presence of gentiopicrin, gentianose, and saccharose in the fresh roots of *Gentiana punctata*.—R. **Dalimier**: The actions of the arseno-aromatic compounds (606 and neo-salvarsan) on the hæmoglobin of the blood. Dioxydiamido-arseno-benzene ("606") is without action of the hæmoglobin of the blood either *in vitro* or *in vivo*. Neo-salvarsan (sodium dioxydiamido-arseno-benzene sulphoxylate), on the contrary, has a marked action of the hæmoglobin. *In vitro* it causes hæmolysis and reduces oxyhæmoglobin; *in vivo* the reduction is not produced, and the hæmolysis rapidly vanishes. For these reasons there would appear to be reasons against the use of neo-salvarsan in certain cases.—V. **Grégoire**: The telophase and the prophase in somatic caryokinesis.—L. **Bounoure**: Observations on the post-embryonic evolution of *Dytiscus marginalis*.—A. Ch. **Hollande**: The figured bodies of the protoplasm of the œnocytes of insects.—P. **Chaussé**: The suspension in air of the virulent particles obtained by liquid pulverisation. A solution of a dyestuff (methyl violet) was sprayed into a room and experiments made on the time of suspension and transportability of the particles. Similar experiments have been made with tuberculous virus.—Albert **Berthelot**: Researches on *Proteus vulgaris* considered as a producer of indol.—Em. **Bourquelot** and J. **Coirre**: Some new data on the reversibility of the ferment action of emulsion.—J. **Stoklasa**, J. **Sebor**, and V. **Zdobnicky**: The synthesis of sugars by radio-active emanations. By the interaction of carbon dioxide and nascent hydrogen in the presence of radium emanations and potassium bicarbonate reducing sugars were obtained.

BOOKS RECEIVED.

Illustrated Catalogue of Physical Apparatus. Pp. 1032+xix. (London: F. E. Becker and Co.)

Three Years in the Libyan Desert. Travels, Discoveries, and Excavations of the Menas Expedition (Kaufmann Expedition). By J. C. E. Falls. Translated by E. Lee. Pp. xii+356+plates. (London: T. F. Unwin.) 15*s*. net.

Die Synchytrien: Studien zu einer Monographie der Gattung. By Dr. G. Tobler. Pp. ii+98+4 plates. (Jena: G. Fischer.) 5 marks.

Die Ontogenie der Primatenzähne: Versuch einer Lösung der Gebissprobleme. By Prof. L. Bolk. Pp. vi+122+2 plates. (Jena: G. Fischer.) 5 marks.

Chemistry of the Oil Industries. By J. E. Southcombe. Pp. xi+204. (London: Constable and Co., Ltd.) 7*s*. 6*d*. net.

A Synopsis of the Elementary Theory of Heat and Heat Engines. By J. Case. Pp. iii+65. (Cambridge: W. Heffer and Sons, Ltd.) 2*s*. 6*d*. net.

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On Aristotle as a Biologist, with a Prooemion on Herbert Spencer. By Prof. D'Arcy W. Thompson. Pp. 31. (Oxford: Clarendon Press.) 1*s*. net.

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The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland. Twenty-ninth Annual Issue. Pp. vii+373. (London: C. Griffin and Co., Ltd.) 7*s*. 6*d*.

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Anales del Museo Nacional de Historia Natural de Buenos Aires. Tomo xxiii. Pp. 415+plates. (Buenos Aires.)

Records of the Survey of India. Vol ii., 1910–11. Pp. iii+157+xi maps. (Calcutta: Superintendent Government Printing, India.) 6*s*.

The Science of Human Behaviour. Biological and Psychological Foundations. By Dr. M. Parmelee. Pp. xvii+443. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Ausführung qualitativer Analysen. By W. Biltz. Pp. xi+139. (Leipzig: Akademische Verlagsgesellschaft m.b.H.)

Geological Survey of Alabama. Iron Making in Alabama. By W. B. Phillips. Third edition. Pp. 254+xxxi plates. (Alabama: University.)

Pharmakognostischer Atlas. By Dr. L. Koch. Zweiter Teil der mikroskopischen Analyse der Drogenpulver. Zweiter Band. 2 Lief. (Leipzig: Gebrüder Borntraeger.) 3.50 marks.

Taschenbuch für Mathematiker und Physiker, 3 Jahrgang, 1913. Edited by F. Auerbach and R. Rothe. Pp. x+463. (Leipzig and Berlin: B. G. Teubner.) 6 marks.

Exercises in Gas Analysis. By Dr. H. Franzen. Translated by Dr. T. Callan. Pp. vii+120. (London: Blackie and Son, Ltd.) 2*s*. 6*d*. net.

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Year-Book of the Royal Society, 1913. Pp. iii+258. (London: Harrison and Sons.) 5*s*.

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Reports of the Committee on Electrical Standards appointed by the British Association for the Advancement of Science. Reprinted by Permission of the Council. A Record of the History of "Absolute Units" and of Lord Kelvin's Work in Connection with These. Pp. xxiv + 783 + 10 plates. (Cambridge University Press.) 12*s*. 6*d*. net.

Psychology and Industrial Efficiency. By H. Münsterberg. Pp. viii + 321. (London: Constable and Co., Ltd.) 6*s*. net.

DIARY OF SOCIETIES.

THURSDAY, March 6.

Royal Society, at 4.30.—An Automatic Method for the Investigation of the Velocity of Transmission of Excitation in Mimosa: Prof. J. C. Bose.—The Evolution of the Cretaceous Asteroidea: W. K. Spencer.—A Preliminary Note on the Fossil Plants of the Mount Potts Beds, New Zealand, collected by Mr. D. G. Lillie, Biologist to Capt. Scott's Antarctic Expedition in the *Terra Nova* in 1911: Dr. E. A. Newell Arber.—(1) Trypanosomes found in the Blood of Wild Animals Living in the Sleeping Sickness Area, Nyasaland; (2) Trypanosome Diseases of Domestic Animals in Nyasaland—II. *Trypanosoma caprae* (Kleine); (3) Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. I. The Human Strain: Surg.-Gen. Sir D. Bruce, F.R.S., Majors D. Harvey and A. E. Hamerton, and Lady Bruce.

Royal Institution, at 3.—Surface Energy: W. B. Hardy.

Institution of Electrical Engineers, at 8.—Recent Developments in the Street Lighting of Manchester: S. L. Pearce and H. A. Ratcliff.

Royal Society of Arts, at 4.30.—Indian Section—The City of Karachi: J. F. Brunton.

Linnean Society, at 8.—*Discussion*: The Development and Inheritance of Sexual Characters—Opener: G. Smith.

FRIDAY, March 7.

Royal Institution, at 9.—Photography of the Paths of Particles Ejected from Atoms: C. T. R. Wilson.

SATURDAY, March 8.

Royal Institution, at 3.—The Properties and Constitution of the Atom: Sir J. J. Thomson, O.M.

MONDAY, March 10.

Royal Society of Arts, at 8.—Coal Gas as a Fuel for Domestic Purposes: F. W. Goodenough.

Royal Geographical Society, at 8.30.

TUESDAY, March 11.

Royal Institution, at 3.—The Movements of the Stars: Our Greater System: Prof. H. H. Turner.

Mineralogical Society, at 5.30.—The Mineral Collection of Thomas Pennant (1726–1798): W. Campbell Smith.—The Minerals and Mineral Localities of Montgomeryshire: Arthur Russell.—A New Stereographic Protractor: Dr. G. F. Herbert Smith.—A (sixth) List of New Mineral Names: L. J. Spencer.

Illuminating Engineering Society, at 8.—The History of Gas-lighting in this Country: W. J. Liberty.

Institution of Civil Engineers, at 8.—Notes on City Passenger-Transportation in the United States: G. D. Snyder.

WEDNESDAY, March 12.

Royal Society of Arts, at 8.—The Use of White Lead in Painting: Noel Heaton.

Institute of Chemistry, at 8.—The Function and Scope of "The Chemist" in a Pharmaceutical Works: C. A. Hill.

Aeronautical Society, at 8.30.—Some Research: A. P. Thurston.

Royal Meteorological Society, at 7.30.—British Weather Forecasts: Past and Present: R. G. K. Lempfert.

THURSDAY, March 13.

Royal Society, at 4.30.—*Probable Papers*: A Simple Method of Finding the Approximate Period of Stable Systems: A. Mallock.—The Motion of Electrons in Gases: Prof. J. S. Townsend and H. T. Tizard.—The Self Inductance of Circular Coils of Rectangular Section: Prof. T. R. Lyle.—Ammonium Ferrous Sulphate and its Alkali-Metal Isomorphs: Dr. A. E. H. Tutton.—The Recombination of the Ions produced by Röntgen Rays in Gases and Vapours: H. Thirkill.—Optical Investigation of Solidified Gases. III. The Crystal-properties of Chlorine and Bromide: Dr. W. Wahl.

Royal Institution, at 3.—Surface Energy: W. B. Hardy.

Institution of Electrical Engineers, at 8.—Power Supply on the Rand: A. E. Hadley.

Concrete Institute, at 7.30.—Discussion of Reports of the Reinforced Concrete Practice Standing Committee on: (1) Cracks in Concrete; (2) Surface Treatment of Concrete.

Institution of Mining and Metallurgy, at 8.—Annual General Meeting.

Mathematical Society, at 8.—Some Cases of Tidal Motion of Rotating Sheets of Water: J. Proudman.—Indeterminate Equations of the Third and Fourth Degree: L. J. Mordell.

Society of Dyers and Colourists, at 8.—Stripping Agents for Garment Dyers: F. G. Newbury.—A Few Notes on Fur Dyeing: M. C. Lamb.

FRIDAY, March 14.

Royal Institution, at 9.—Great Advance in Crystallography: Dr. A. E. H. Tutton.

Institution of Mechanical Engineers, at 8.

Physical Society (University College, Gower Street), at 5.—Demonstration of Spark Photographs: W. B. Haines.—(1) Some Oscillograms of Condenser Discharges and a Simple Theory of Coupled Circuits; (2) Exhibition of Braun Kathode-Ray Tubes and an Electrostatic Machine for Working them, used as a High-frequency Oscillograph: Prof. J. A. Fleming.—The Stretching and Breaking of Sodium and Potassium: B. B. Baker.—The Latent Heat of Evaporation of Aqueous Salt Solutions: R. G. Lunnor.—Some Flame Spectra: Dr. E. N. da C. Andrade.

Royal Astronomical Society, at 5.

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Royal Institution, at 3.—The Properties and Constitution of the Atom: Sir J. J. Thomson, O.M.

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THURSDAY, MARCH 13, 1913.

THE PHILOSOPHY OF ENERGY.

Der energetische Imperativ. Erste Reihe. By Wilhelm Ostwald. Pp. iv+544. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1912.) Price 9.60 marks.

IT was at the Leeds meeting of the British Association in 1890 that three foreign chemists, van't Hoff, Arrhenius, and Ostwald, propounded and defended a new theory of solution which has since then been generally accepted. One of them, Wilhelm Ostwald, simultaneously imported another germ of thought, which for some years afterwards exercised the minds of Poynting, Lodge, Heaviside, and numerous other physicists. It was a development of the conception of the conservation of energy. It was the question as to whether energy, being indestructible, had an existence independent of matter, whether it retained its identity, and whether it could be followed up from point of point of space in its various transformations.

To Ostwald the idea came with the force of a revelation, and in the work before us he describes his "spiritual" experience with the most engaging candour. He confesses that the idea of the identity of energy and its commanding importance as the most fundamental of all realities has coloured and controlled his whole subsequent life.

This conception has undergone many vicissitudes. The Deutsche Naturforscher at Lübeck in 1895 appeared to dispose of it finally, and its discussion on that occasion was described as a "summary execution." Ten years afterwards Einstein put forward a plea for the identity of matter and energy, equating one gram with v^2 ergs, where v is the velocity of light in cm./sec. Planck's more recent hypothesis of the discrete or atomic structure of radiant energy lends unexpected support to Ostwald's original conception, and although it is difficult to see much advantage in substituting an elusive entity like energy for matter as a fundamental reality, it is quite possible that the identity of energy may play a considerable part in the future development of theoretical physics.

The present volume is a collection of essays strung (somewhat loosely sometimes) upon this central idea, propounded in the form of a precept which the author calls the "energetical imperative." This precept enjoins us never to waste energy, but to utilise it in its highest form. The four sections of (1) philosophy, (2) organisation and internationalism, (3) pacifism, (4) education, and (5) biography serve to group these essays with regard to the author's activity as a publicist.

In reading these brilliant essays, one is not surprised at the sobriquet of the "genial revolutionary" which their author earned among his friends in Leipzig. The energetical imperative is vigorously used to enforce economy and efficiency of organisation. It is propounded and proclaimed as the supreme guide in mundane matters, from the establishment of new universities to the binding of books. In organising, let us say, the science of chemistry, it is necessary to begin with the most commonplace details such as the spelling and division of words and the size of the printed page. Thus a "Weltformat" for printed books, based upon the centimetre, is suggested. It is designed in such a manner that every size can be obtained by the successive duplication of the smallest fundamental size, the sides of which are 1 cm. and $\sqrt{2}$ cm. respectively. No. 2 size is $\sqrt{2}$ by 2 cm., and so on. No. 9 size, 16 by 22·6 cm., is proposed as a universal size for scientific periodicals; No. 8 size, 11·3 by 16 cm., is a convenient pocket size; and No. 10, 22·6 by 32 cm., a good quarto.

Then we find a proposal to adopt one gram of pure gold as the basis of an international currency, and another to abolish the months of the calendar and count the days in numerical order. If, in addition, January 1 is made a supernumerary Sunday, with a similar interpolation at midsummer in leap years, the difficulty of determining days of the week is greatly reduced. The reading of numbers in thousands, hundreds, and the other powers of ten is to be abandoned, and numbers are to be read by a simple succession of figures, as is already the practice in quoting telephone and motor numbers. This reform applies, of course, with greater force in France or Germany than in England.

Then follows, very properly, the question of an international language. Ostwald is an enthusiastic supporter of the principle of an artificial international language, and defends it with conspicuous force and ability. Dr. Zamenhof's "Esperanto" was, by common consent, the finest and most successful solution of this problem hitherto proposed, and one naturally would have expected a born organiser like Ostwald to make the most of it. But his action in supporting Couturat's improved Esperanto ("Ido") was a very serious blow to the cause of Esperanto and of any artificial world-language. No doubt the abolition of the accented consonants was intended to facilitate the work of printing, but no such consideration justified the abandoning of the accusative case which gives Zamenhof's "lingvo" its marvellous flexibility.

C

If either of the rivals could thoroughly vanquish the other, or if they could settle their few differences, all would be well, but time alone will show whether Ostwald was in this instance a friend or foe of progress.

The author's proposal to divide words at any letter instead of by syllables would scarcely get rid of the difficulty of spacing out the line. Incidentally, one is led to hope that such blemishes as the substitution of "Zukunft" for "Folgezeit" (p. 484, line 4) and the adjective "vielfachen" for the corresponding adverb (p. 384, penultimate line) are accidental slips rather than premature reforms.

The distinguished founder and editor of the *Zeitschrift für physikalische Chemie* is at his best in discussing university problems, whether in connection with his biographical notes on Curie, van't Hoff, Abbe, and Ramsay (the latter was originally written for NATURE), or with the proposed foundation of new universities at Hamburg and Frankfort. He maintains that the unit of the future university must not be the faculty, but the laboratory, the institute, or the clinic. Teaching must be by work rather than lecture, and the work must be under the personal direction of a capable and enthusiastic chief in close touch with theoretical advances and practical problems.

The process of reasoning by which the irreversibility of all actual transformations of energy is made a fundamental ethical principle is one of daring originality. If, says Dr. Ostwald, occurrences were completely reversible (like ideal mechanical processes), then any mistake or wrong action could be completely annulled by reversing it. In fact, the whole world-history would read just as consistently backwards as forwards. What gives purpose and value and choice to life is the inevitable dissipation of energy. This must be directed into the most fruitful channels and put to the best use before it is lost in space. Peace is more fruitful and less wasteful than war, hence peace is good and war is bad. This is probably the first occasion on which a general physical law has been made the foundation of a system of ethics.

E. E. FOURNIER D'ALBE.

THE PRESENT POSITION OF RADIO-ACTIVITY.

Radio-active Substances and their Radiations. By Prof. E. Rutherford, F.R.S. Pp. vii+699. (Cambridge University Press, 1913.) Price 15*s.* net.

MUCH water has flowed under the bridge since 1906, when the second edition of Prof. Rutherford's "Radio-activity" was reviewed in NATURE by the present writer. Though its title has been changed, the work is not essentially different in plan from its predecessor. The fundamental aspect of the subject has not changed, but the pioneer investigations have for the most part been supplemented, and in a sense superseded, by subsequent work traversing the same ground, and the author has found it impossible to incorporate the newer work satisfactorily without entirely rewriting the book.

A pioneer has to encounter all the uncertainties of a voyage into the unknown. A vast expanse often lies before him. He has great difficulty in reaching the unknown country, and cannot survey it in the leisurely and methodical manner which is afterwards attainable. His first hurried impressions must often be erroneous. It is no easy matter to hold the due balance between the credit which properly belongs to him and that due to the successors who tread in the path which he has made. The skilful way in which this has been accomplished is a feature of the present work.

The process of gleaning after the original rich harvest is as yet far from complete. It is an open secret that Prof. Rutherford and his colleagues are now engaged on a revision of their fundamental determination of the properties of the α particles. We may confidently expect that the charge, the electrochemical equivalent, the velocity of expulsion, and the number of α particles emitted by radium will soon be established within a fraction of 1 per cent. It is scarcely to be hoped, however, that these researches will be so immediately fruitful as were the less accurate determinations which they will supersede.

The mass of detailed knowledge which Prof. Rutherford is now able to record may suggest that the wonderfully productive vein opened by Becquerel's discovery of radio-activity is approaching exhaustion. It may be that this view is not without foundation. The number of radio-active substances now known is no fewer than thirty-four, as against twenty recorded in 1906. It scarcely seems likely that the next six years will see an equal addition to the number, though prophecy on such subjects is notoriously rash.

In this connection it may be remarked that progress has not for the last few years altogether followed the lines that might have been anticipated. Some of the more obvious problems have been little pursued, such as the isolation of pure actinium and ionium and the determination of their atomic weights. The position of actinium in the disintegration series is still a mystery. We are still unable to state definitely whether atomic transformation ever occurs without the emission of any ionising radiation, though the steadily diminishing proportion of products regarded as "rayless" suggests an answer in the negative.

Finally, we know little more than before of the nature of the final products of radio-active transformations. In the case of radium, we have, indeed, strong indirect evidence that lead is the product, but direct evidence is still wanting. The recent investigations of Prof. Rutherford's school on "lateral disintegration," *i.e.* the formation of collateral branches of descent, make it not improbable that more than one final product of thorium exists. It may be hoped that now that powerful mesothorium preparations are produced commercially, a direct chemical investigation of these final products may eventually prove feasible. Each such final product identified may be expected to form a link connecting up common elements with the scheme of radio-active evolution. The early hopes of bringing these elements into the scheme have been disappointed. The β radiation of potassium and rubidium remain isolated and perplexing facts. It may be that the studies now so eagerly pursued on the *rôle* of β rays in the more rapid changes associated with the radium series will afford a clue.

The principal focus of interest at the present time is indeed in connection with the β and γ rays. The discovery of v. Baeyer, Hahn, and Meitner that the β rays from certain radio-active bodies can, by improved technique, be resolved into a line spectrum by the magnet has given the lead which was needed, and now we begin to see order and definiteness where all appeared before to be hopelessly involved.

In this subject, as in all others which have arrived at any maturity, the labour of keeping abreast of the literature becomes increasingly heavy, and the value of a complete and authoritative treatise up to date proportionately great. Even more gratitude will be felt to the author by workers in this field for the present work than for its predecessors. R. J. Strutt.

MAP PROJECTIONS.

Map Projections. By Arthur R. Hinks. Pp. xii+126. (Cambridge: University Press, 1912.) Price 5*s*. net.

NOTWITHSTANDING the large amount of surveying which has been done in this country and throughout the Empire, there are few works in English which treat of the various ways in which portions of the earth's surface may be most conveniently and correctly represented on the plane surface of a map. The subject has been treated partially by several eminent mathematicians, and valuable summaries occur in some encyclopædias, but we do not in this country possess any works such as those by Germain, Tissot, Hammer, and others. There are also many works of a less advanced type which are available to Continental geographers, but this class, too, is very insufficiently represented here. We therefore welcome the appearance of the present volume, in which the subject is treated clearly and in a manner which makes but small demand upon the mathematical training of the geographer, while at the same time the important points in any projection, suitability for special purposes, and facility of construction are given especial prominence.

After indicating the inevitable limitations of all projections, in representing length, area, and shape of any portion of the earth's surface, the author reviews the principal systems, and here the question of nomenclature has to be faced. There is as yet no general agreement in this matter, and the same projections are differently named by different writers, and in different counties. In the present work it is laid down that the first name of a title should describe the method of construction, a second name should indicate its principal quality, while the author's or introducer's name may be added in the case of projections which are specially associated with any individual. But even this arrangement cannot as yet be conveniently used in all cases, and several well-known projections are referred to by their usual names.

This difficulty of a suitable classification certainly increases the difficulties of the beginner, so that a tabular statement of the principal projections in this part of the book would be a useful addition. Conical, cylindrical and zenithal, as well as certain conventional projections, are well described and clearly explained, their special advantages and points of weakness being indicated. A chapter on the projections in actual use is an instructive addition, especially as at the present time there is much more activity in selecting the most suitable projections, both for wall-maps and for atlas maps, than was formerly the case.

The chapter on the simple mathematics of projections treats of the theory of each particular case, and discusses the errors which may arise in its use under different conditions. Several actual examples are worked out, so as to show the procedure in a particular case. The present volume will be of great use to all geographers, and should pave the way for a more serious study of cartography on scientific lines than yet generally obtains. Great care and labour are expended on the measurement of various regions in order to produce trustworthy surveys, and the utilisation of the results should be based on sound cartographical principles, and in such work this book will be a valuable assistance.

H. G. L.

OUR BOOKSHELF.

Miners' Nystagmus: its Causes and Prevention. By Dr. T. Lister Llewellyn. With a preface by Prof. J. S. Haldane, F.R.S., and a legal appendix by Douglas Knocker. Pp. xix+158+plates. (London: *The Colliery Guardian* Co., Ltd., 1912.)

Miners' nystagmus is a disease which incapacitates a large number of coalminers, and is estimated by Dr. Lister Llewellyn to cost the country 100,000*l.* a year. It is characterised by rapid involuntary movements of the eyes, associated with defect of vision, photophobia, and night-blindness. Many theories have been brought forward to account for the disease. Of these the myopathic theory has been most supported in England, chiefly owing to the writings of the late Mr. Simeon Snell, of Sheffield. The work is carried on in constrained positions, often necessitating prolonged exercise of the extra-ocular muscles in an abnormal manner. It is now generally admitted that undue weight was attached to this factor, and attention has been specially directed to the view that the real cause is the poor illumination, a suggestion first made by Romiée, who, however, thought that excessive accommodation was an essential concomitant.

Dr. Llewellyn, as a former medical officer to a South Wales coal and iron company and as Tyndall Research Mining Student of the Royal Society, has had excellent opportunities for investigating the disease. He has used his opportunities to the full, and his work is a model of what such a research should be. He has shown conclusively that miners' nystagmus is practically limited to coal mines in which safety lamps are used, those in which naked candles are employed being exempt except for cases which have been transferred from safety-lamp mines. He has made exhaustive inquiries into the conditions of work and the illumination at the coal face. The estimations of illumination appear to have been made with great care and accuracy, and the same may be said of the clinical investigations. In addition to his own researches, his book contains an admirable *résumé* of the opinions and work of previous writers on the subject. The criticisms are judicial in tone, and the exposition of his own views allows the facts and arguments to carry conviction without undue stress. The work is of interest not only to those specially associated with the mining industry, but also to the physician and physiologist. We consider that Dr. Llewellyn has accomplished a difficult task with distinguished success.

Catalogue of the Lepidoptera Phalaenae in the British Museum. Vol. xii.: Catalogue of the Noctuidæ in the Collection of the British Museum. By Sir George F. Hampson, Bart. Pp. xiii+626. (London: Printed by Order of the Trustees, 1913.) Price 17*s.* 6*d.*

The subject of this volume of the "Catalogue of Moths" is the classification of part of the Noctuid subfamily Catocalinæ. The remaining portion of the subfamily, together with the small subfamilies Mominæ and Phytomatrinæ, will appear in vol. xiii. The Catocalinæ are represented in the present volume by sixty-three genera and 643 species, and are characterised as follows:—Vein 5 of the hind wing is developed fully and arises close to the lower angle of the cell; the eyes are smooth and not overhung by "cilia"; the mid tibiæ are always spined, and the fore and hind tibiæ may also be armed similarly. The subfamily is a modification of the Quadrifid section of the Noctuidæ; it is distributed fairly evenly in the temperate and tropical zones, but has few arctic or alpine forms.

Volcanoes: Their Structure and Significance. By T. G. Bonney. Third edition. Pp. 379. (London: John Murray, 1912.) Price 6*s.* net.

Prof. Bonney's well-known volume was reviewed at length in the issue of Nature for May 11, 1899 (vol. lx., p. 27), at the time of its first publication. Many minor alterations have been made in the present edition, and several paragraphs inserted dealing with volcanic eruptions which have take place recently. The chapter on the theories of volcanoes has been considerably modified so as to incorporate the results of research accomplished during the last fourteen years. Some new illustrations also have been added.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Radio-elements and the Periodic Law.

At a meeting of the Royal Society on February 27th, Mr. F. Soddy made a verbal communication which was published under the above title in the *Chemical News* of the following day. The importance of the conclusions which are drawn justifies an examination of the evidence on which they rest. I do not approach the question unsympathetically, and I am quite willing to take some risks, but, when asked to accept a theory, I like to draw a distinction between a guess, a reasonable generalisation, and a well-established conclusion. If Mr. Soddy only wishes to put forward a theory which is not inconsistent with the facts so far as they are known at present, I have nothing to say, but if he claims anything approaching to experimental proof, some critical comment may be forgiven.

Mr. Soddy believes in the existence of a number of bodies which differ in molecular weight but "are non-separable by any known process"; these are also supposed to have identical spectra. Among "known processes" I count gravitation, diffusion, and mechanical processes, such as separation by centrifugal forces, among which diffusion, perhaps, is the only available one. Is there any reason to suppose that molecules which, ex hypothesi, differ in mass, cannot be separated by diffusion? Some of the bodies concerned are gaseous, others no doubt are volatisable, and though diffusion may not act very effectively, owing to the close approximation of the densities, the presumption is that the molecules, having different masses, travel with different speeds, and that it is therefore incorrect to call two gases with different densities "non-separable by any known process."

Electrical and magnetic forces are also agents which can be applied to distinguish between molecules having different masses. Such forces should be considered before any sweeping assertions are made.

It is possible that Mr. Soddy wishes his statement to be limited to the ordinary chemical processes, and as he is trying to prove a negative, it is perhaps unfair to be too critical, but one cannot help remembering the time when neodym and praesodym were "non-separable," and reflecting how many substances might not be separated at the present moment if their optical properties had not given us a clue. No doubt radio-active tests are severe, and the chemical properties of the bodies in question are probably more nearly equal than those of the older chemistry, but there is a vast interval between "very similar" and "identical."

Incidentally, we may reflect that these bodies which are believed to be "non-separable" actually separate themselves of their own free accord in the natural course of their subsequent history, but this may only prove the perversity of nature.

According to Mr. Soddy's theory, the non-separable bodies have identical spectra. This is the vital issue, which, if made good by experiment, will help us to overlook many weaknesses in the argument. The evidence here rests entirely on one experimental fact. It was shown by Russell and Rossi, and also by Exner and Haschek, that a mixture of ionium and thorium does not show in the electric arc lines which can be assigned to ionium, the spectrum of the mixture being identical with that of pure thorium. Assuming that ionium is the only intermediate product between thorium-II. and radium, the life of ionium is 100,000 years, and the ionium-thorium preparation of Russell and Rossi must have contained about 16 per cent. of ionium. But these authors also point out that if the length of life is reduced to 12,000 years, the preparation would only contain 2 per cent., and the absence of ionium lines would be accounted for. At present the radio-active evidence seems in favour of the longer period, and the absence of ionium lines wants explaining; nevertheless, it seems to me to be going ahead too quickly to make a sweeping assertion that not only is the spectrum of ionium identical with that of thorium, but that the same holds in all similar cases, for the accumulated evidence of the spectra of known bodies has all been in the direction of indicating that optical properties of absorption and radiation discriminate in the most decisive manner between bodies which are otherwise similar in chemical properties.

Granting now for the sake of argument that the bodies in question have spectra which cannot be distinguished from each other, it remains to examine the alternative that the bodies are actually identical. It is said that they have different molecular weights, because one has been formed from the other by an expulsion of one α and two β particles. This argument is not necessarily conclusive, as a mass equal to that expelled may have been picked up again in the process. It may be urged that the subsequent history of these bodies shows that they are essentially different. Though a strong argument, this is not quite the last word, because, granting for a moment the temporary identity of two systems, the particular instability which determines their future may depend on their past.

Taking all arguments into consideration, we are left with an interesting theory consistent with our present knowledge but supported by very little real evidence. It may be presumptuous for one who can only claim to be an amateur in modern physics to express an opinion, but having in a previous generation taken part in establishing the fact that the same element can have different spectra according to its molecular constitution, one cannot, without good cause, accept the belief that different elements can have the same spectrum. Mr. Soddy's case would be much strengthened if he could adduce positive instead of merely negative evidence, and this might be supplied if the bodies grouped together with thallium lines could be shown to give the thallium spectrum, assuming thallium not to be present in the raw material.

ARTHUR SCHUSTER.

Manchester, March 7.

Atmospheric Electrification during South African Dust Storms.

THIS short note on the variation in the atmospheric electrical charge due to the presence of dust is not intended to be exhaustive, but merely to direct attention to a factor which has a very great influence in modifying the positive potential gradient existing in the atmosphere during fine weather. Very few observations as to the causes of the variations have been recorded, but Prof. Michie Smith seems to have observed (*Phil. Mag.*, vol. xx., p. 456) something of the same kind during dust storms in India. He notes that "the negative electrification was strongest during gusts of dust-laden air," and, further, "the potential would often run up so rapidly that it was impossible to measure it accurately, whilst during lulls it would often fall almost to zero."

I was, however, unaware of any work having been done in this direction until the present year, though I have been making a study of the variations in the potential gradient over the high veld in South Africa, and have published several short papers on the subject.[1] The general result has been to show that very extraordinary variations are caused by the presence of dust in the atmosphere, whether due to the natural dust-storms or to any artificial means, such as the clouds of dust raised from the mine refuse heaps formed during the working of the cyanide process. At all the places where observations have been taken the dust is either sand or is of siliceous character, and invariably has the effect of lowering the positive potential gradient, and if present in sufficient quantity, to reverse it and give a very high negative gradient.

During the past six months systematic observations have been taken at Bloemfontein with a Bendorf recording electrometer, furnished with a radium-coated plate to act as collector. (The apparatus was obtained by aid of a grant from the Royal Society of South Africa.) The normal potential gradient in South Africa is, of course, positive, but varies considerably with the elevation. The diurnal range is also considerable under fine weather conditions, and during stormy weather very great deviations are shown if rain is falling or dust is blowing. It may be noted here that during the past eighteen months, when very little rain has fallen, the charge brought down by the rain has been invariably negative. A study of the records made by the electrometer shows that three types have to be considered, viz. :—(1) The ordinary fine weather record; (2) record taken on a day when some dust is blowing; (3) record taken on a very dusty day.

In the first case, the positive gradient rises to a maximum at about 7 to 8 a.m., falls to a minimum at midday, remains fairly uniform over a period of several hours, and then rises to another maximum. The slope of the curve is steeper for this second maximum than for the first one. Fig. 1 shows such a curve which was taken in July, from midnight to midnight. The horizontal line shows zero potential,

[1] *South African Journal of Science*; Proc. Roy. Soc. South Africa.

and distances measured above give positive values, and those below negative. The extreme range of the scale is equivalent to a gradient of 380 volts per metre.

Fig. 2 gives the record for a dust-storm which lasted the greater part of the day. In this figure it may be seen that the positive value never goes beyond 70 volts per metre, and on one occasion even becomes slightly negative.

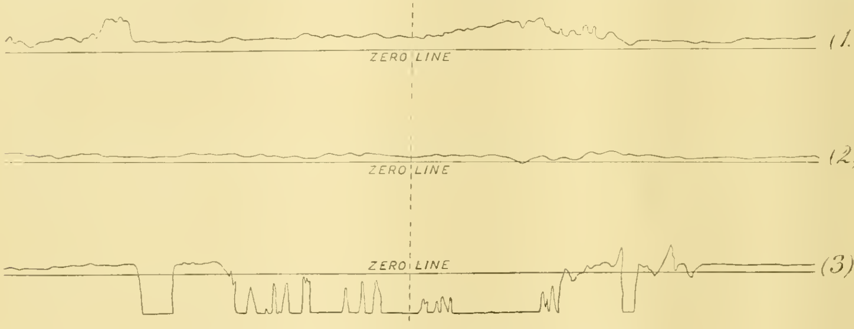
Fig. 3 records a severe dust-storm which lasted from 4 a.m. until 8 p.m. The maximum value of the negative gradient cannot be inferred from the curve because the electrometer needle was deflected as far as it could go, and the horizontal portions of the curve indicate that the potential gradient was higher than the maximum which could be recorded. It will be shown presently that the gradient may reach the value of 5000 to 10,000 volts per metre when the dust is blowing thickly.

The writer has shown (*Phil. Mag.*, May, 1912) that during a dust-storm the charge upon the dust (if siliceous) is positive, while that upon the air at the same time is negative, and he was led from this to devise an electrical machine by means of which charges of both positive and negative electricity might be obtained during a dust-storm. The essential parts are:—(1) A small insulated disc coated with radium attached to a wooden rod about two metres in height; (2) a large hollow vessel with a fine wire gauze bottom; and (3) a pair of insulated spheres to serve as dischargers. The hollow vessel generally used was a five-gallon petrol tin supported upon an insulated rod at a distance of about 20 cm. above the ground, and directed with the open end towards the onrushing dust. Much of this dust is carried through, but a considerable portion is retained, and any charge it may possess is given up to the vessel. *This charge was invariably positive.*

The radium-coated conductor, however, took the negative potential of the current of air blowing past it, so that the two balls acquired opposite charges, and a torrent of sparks as continuous as that furnished by an induction coil passed between them. On some occasions the sparks reached a length of 1·5 cm., showing that the potential difference between the conductors must have been at least 40,000 volts when the apparatus was set up on the open veld.

An ordinary vacuum tube having a radium-tipped wire attached to an electrode, the other electrode being earthed, will light up brilliantly during the passage of a dust-storm. A brush discharge is seen to proceed from the electrode and the shape of the brush makes it quite clear that positive electricity is escaping from the earth into the atmosphere.

W. A. DOUGLAS RUDGE.



(1) Normal fine weather record (2) a mild dust-storm; (3) a severe dust-storm.

Induced Cell-reproduction in the Protozoa.

IN the interesting letter by Mr. A. H. Drew, under the above heading, in NATURE, February 20, it is suggested in the last paragraph that certain substances called auxetics which caused the development of spores in the case of new species of Polytoma, may be necessary for cell-reproduction under natural conditions in ponds, &c., where such substances would probably occur owing to the putrefaction of organic matter.

In the course of an investigation which I have recently carried out on the process of excystation in the ciliated infusorian, *Colpoda cucullus*, from its resting cysts, I have found that this organism can emerge from its cysts when the latter are incubated in 1 per cent. hay infusion (alkaline or acid in reaction) and in pure distilled water—media quite free from auxetics. The real agent which is instrumental in causing excystation is an enzyme which digests the endocyst, and thus allows the organism to swim out into the surrounding medium. As is well known, *Colpoda cucullus* is an organism of wide distribution and of common occurrence in ponds and in infusions of hay, &c. It can frequently be found among rotting grass and decaying vegetation; situations in which the products of organic decomposition and bacterial putrefaction would be plentiful, yet the cysts of this organism can be caused to rupture and yield their contents in active condition when incubated in pure water.

I would therefore suggest that it is unsafe to infer that because auxetics may serve to induce cell-reproduction in certain cases, they may be necessary in all.

The winter spores of Polytoma and the resting (dauer) cysts of Colpoda are not perhaps quite comparable, but I may point out that Colpoda most frequently encysts in the condition of the resting cyst, and that therefore if auxetics are necessary at all they ought to be required for excystation from this condition.

An account of my investigations on this subject will shortly be published. T. GOODEY.

Rothamsted Experimental Station, Harpenden, Herts, March 4.

The Spectra of Neon, Hydrogen, and Helium.

IN a letter published in NATURE of March 6, Prof. Fowler pointed out that a series of "parallelisms" that we gave of lines in the spectra of neon and hydrogen were probably coincidences, and could not be taken as evidence of identity. We are sorry that we did not make our meaning plainer, in our letter in NATURE for February 27, for we did not mean that the lines we compared in the two spectra were identical. The numbers we used were by Watson, and both spectra were measured from plates produced by the same instrument, and, of course, measured by the same person; thus experimental error was eliminated so far as possible. We were, however, in hope that possibly some similarity in atomic complexity might be argued from this "parallelism." But on talking the matter over with Prof. Fowler, whose knowledge of the subject is far greater than ours, we see that the evidence is not sufficient to justify any such assumption of similarity in the atomic complexity of these two elements, and we must therefore with regret abandon the idea.

J. NORMAN COLLIE.
HUBERT S. PATTERSON.

Mountain Stream Tadpoles in Natal.

SOME readers of NATURE will be interested to learn that tadpoles with large suctorial oral discs, enabling their possessors to adhere firmly to the rocks and boulders of mountain streams, have recently been discovered at Krantzkloop, in Natal, at an elevation of about 1500 to 1600 ft. They were found by the Rev. Fr. P. Boneberg, of Mariannhill, who kept them alive for some time, and observed their peculiar leech-like habit of sticking to one's fingers or to the sides of the vessel in which they were contained. Similar tadpoles have long been known from mountain streams in Borneo and other parts of the East, but so far as I can ascertain have not previously been recorded from Africa. However, the Natal tadpole belongs to the family Cystignathidæ (genus Heleophryne), whereas those of the Oriental region belong to the family Ranidæ, so that the adaptations are no doubt quite independently evolved. A description of this tadpole will be given in the next issue of the Annals of the Natal Museum.

JOHN HEWITT.

Albany Museum, Grahamstown, South Africa,
February 1.

[IN his recently published account of the Batrachia of the Abor expedition, Dr. Nelson Annandale directs attention to some of the tadpoles (from Himalayan streams) which adhere to stones at the bottom or sides, and even in the vicinity of waterfalls. The majority adhere by their lips, which may be monstrously developed. In some other species a sucker, quite separate from the lips, and not homologous with the sucker that many young Batrachian larvæ possess, is found on the ventral surface, doubtless for the same purpose. It is interesting to note that some fishes have similar adaptations for adhesion.—ED. NATURE.]

INTERNATIONAL TIME AND WEATHER RADIO-TELEGRAPHIC SIGNALS.

IT is to the French Government that the world is indebted for the institution of an international conference on the radio-telegraphic distribution of time and weather signals. So long ago as 1908 the Bureau des Longitudes suggested a series of hourly signals from the Eiffel Tower for the determination of longitudes, and this service was brought into active operation in 1910. The great success which the service met with called for a more universal use of it, and to this end the French Government invited a certain number of foreign Governments to send delegates who had studied the problem of radio-telegraphy from the point of view of time and the determination of longitudes.

In October of last year such a conference was assembled, and programmes were formulated and resolutions passed with the object of preparing the way for the distribution of time and weather signals at stated hours from numerous selected stations suitably situated over the globe.

The outcome of this, the first international conference convened for this purpose, was a series of very important resolutions, but reference will only be made here to those that deal with the international time and weather signals. It may be of interest briefly to describe in the first instance samples of two signals that are being daily distributed at the present time, in order that the reader may compare them with the full international system which will be brought into operation on July 1 next.

Our purpose will be served if those sent out from the Eiffel Tower, Paris, and from Norddeich-Wilhelmshaven be alone considered, as these will show the different procedures adopted. To take the French signals first as recorded by a receiver in London. From this station morning and evening signals are transmitted, and at each transmission three separate "minute" signals are sent. Thus in the morning the observer can hear the tap from the pendulum clock in Paris at 10h. 45m. 0s., 10h. 47m. 0s., and 10h. 49m. 0s., and in the evening at 23h. 45m. 0s., 23h. 47m. 0s., and 23h. 49m. 0s., the clock indicating Greenwich mean time. In order to warn those who intend to receive the signals wherever they may be, a certain procedure is adopted which is the same for both morning and evening transmissions. This procedure is as follows:—

Let us suppose that we wish to correct our watch and therefore require to hear the morning signals. At about 10h. 40m. one sits by the receiving apparatus with the telephone fixed on the head, the coils set for the wave-length in use (about 2000 metres) and the detector adjusted, and waits for the preliminary signals. It may be mentioned here that the noise heard is of a powerful medium note, and the operator transmits the individual signals quite slowly so that they are easy to decipher.

The first sounds to be heard are the signal ta-te-ta-te-ta (-.-.- repeated three times, which is a "call" signal in Morse preliminary to every transmission. Then follows -...-, which means (=), a signal to separate the "call" from that which follows. The operator transmitting then sends out the following in Morse:—

.--. .- .-. .. ... --- -... ... . .-. ...- .-
P A R I S O b s e r v a

- --- .. .-. .
t o i r e

-...-
(double dash)

... .. --. -. .- ..- -..- .... --- .-. .- ..
s i g n a u x h o r a i

.-. . ...
r e s

.-... .-... .-... .-...

The last four signals indicate "wait," repeated four times.

The foregoing announcement is the preamble preliminary to the time signals.

At 10h. 44m. 0s. a series of longs or – – – –, &c., are transmitted, ceasing at 10h. 44m. 55s.; then there is silence for some seconds, and *exactly* at 10h. 45m. 0s. a single "short" is heard.

A whole minute is then allowed to elapse with no signal at all, but at 10h. 46m. 0s. a new series of signals is commenced –·· –·· –··, &c., until 10h. 46m. 55s. is reached, when again there is silence for a few seconds, and then a short tap at *exactly* 10h. 47m. 0s. Another minute of silence is then allowed to pass, and at 10h. 48m. 0s. a different series of signals is commenced –···· –···· –····, &c., terminating about 10h. 48m. 55s., when after a few seconds' silence the single tap that follows indicates *exactly* 10h. 49m. 0s.

Thus it will be observed that the hearer has not only three opportunities of correcting his timepiece, but if by chance he missed the first signal at 10h. 45m. 0s. he can identify the other minutes by the different signals which precede them.

In the case of the German signals transmitted from Norddeich-Wilhelmshaven, at about 12 o'clock midday and 10 o'clock in the evening, the procedure is quite different. The first notification is the transmission of a series of V's thus, ···– ···– ···–, &c., to give the hearers a chance to tune their instruments to the wave-length in use (about 1750 metres) if not already in adjustment. The "call" signal –·–·– is then sent out, followed by the "call signal" of the station transmitting, namely, Norddeich, thus $\underset{\text{K}}{-\cdot-}\ \underset{\text{N}}{-\cdot}\ \underset{\text{D}}{-\cdot\cdot}$. The fact that Greenwich mean time is being sent is given in the next signal in the form $\underset{\text{M}}{--}\ \underset{\text{G}}{--\cdot}\ \underset{\text{Z}}{--\cdot\cdot}$, where MGZ indicate Mittel Greenwich Zeit. At 11h. 58m. 38s. the signal –·–·– or attention is repeated, and then follows the following series of signals:

Commencing at 11h. 58m. 46s., a tap is heard at *every second* until 11h. 58m. 50s. is reached; then a short pause is made, and another series of taps from 11h. 58m. 56s. to 11h. 59m. 0s.; again another pause, and a third series from 11h. 59m. 6s. to 11h. 59m. 10s. Then follows a longer pause, and a similar series of taps is heard for each of the intervals 11h. 59m. 36s. to 11h. 59m. 40s., 11h. 59m. 46s. to 11h. 59m. 50s., and 11h. 59m. 56s. to 12h. 0m. 0s. A few seconds after the last tap the signal –·–·· indicating the end of transmission is given.

The above two examples show what very different systems are in use for the distribution of time by radio-telegraphy. They serve further to indicate that unless some international scheme is at once brought into operation, many other different systems may be added.

The Paris International Conference has thus stepped into the breach at the right moment and brought out a scheme which will be universally adopted and commenced on July 1 of the present year.

It is proposed for the international scheme that Greenwich time should be used throughout, and that the time signals should be transmitted at exact hours. It was further arranged that there should be no overlapping, *i.e.* that no two stations should send out signals at the same hour, and that the same wave-length (about 2500 metres) should be universally adopted.

A preliminary list of stations that will be in active operation by July 1 is as follows, and the times at which they will transmit their signals are added:

	Greenwich civil time. Hours
Paris	0 (midnight).
San Fernando (Brazil)	2
Arlington (U.S.A.)	3
Manilla	4 (provisionally).
Mogadiscio (Italian Somaliland)	4
Timbuctu	6
Paris	10
Norddeich-Wilhelmshaven ...	12 (midday).
San Fernando (Brazil)	16
Arlington (U.S.A.)	17
Massowah (Erythrea)	18
San Francisco	20
Norddeich-Wilhelmshaven ...	22

Since September 1, 1912, radio-telegraphic time signals have been daily sent out from Chōshi, on the eastern shore of Japan. They are transmitted at 9 p.m. Japanese standard time, *i.e.* at Greenwich noon. This station will no doubt adopt the international scheme.

An important part of the scheme that is desired, and will ultimately no doubt be accomplished, is that both a day and a night signal can be received at any point on the globe.

Now as to the method which will be adopted for distributing the exact time at all transmitting stations.

To make the system quite clear, the accompanying figure (Fig. 1), taken from the report of the conference as recorded in the *Comptes rendus* (November 4, 1912, No. 19, vol. clv., p. 872), is shown. The reader is supposed to commence the time reckoning from the innermost portion of the spiral.

At three minutes before the hour—that is, at any hour at which the signals are intended to distribute the time—the transmitting operator sends out a series of successive similar preliminary signals, a repetition of the letter X in Morse –··– –··– –··–, &c. These commence at the beginning of the 57th minute, and continue until 57m. 50s. has been reached. Then, beginning at the 55th second, three longs are given at intervals of one second, each long *lasting one second*. In the 58th minute a short (lasting for a *quarter* of a second), preceded by a long commencing two seconds before, heralds every tenth second, and at the 55th second three longs as before are signalled. During the 59th minute two longs, preceding the quarter-second tap at every tenth second, are transmitted, and this minute concludes as before with the three longs at seconds intervals.

By following the spiral outwards and noting the positions of the longs and shorts in relation to the divisions in seconds on the outer circle, the system can be easily understood.

It will thus be seen that each short signal or tap will give the receiver a chance of comparing his clock, and the dissimilar preliminary signals will inform him whether the minute involved is the 58th or 59th.

When all stations bring this excellent and very simple system into operation, it will be most easy for anyone unacquainted even with the Morse alphabet to check their clocks correctly.

Now while the above arrangements as regards the distribution of time will come into force on July 1 next, the questions as regards the type of weather messages, which will be transmitted directly after the time signals have been sent out, are not yet settled.

There is little doubt, however, that each transmitting station will send out a general description of the air movements over a wide area of which the station is about a centre, and also some definite data as regards certain specified stations useful for that area.

At the present time both Paris and Norddeich send out such messages, and it may be of interest to describe the procedure now followed at the former station, for it is probable that little, if any, change will be made with regard to the system there in vogue.

Let us suppose that the time signals at 10h. 45m. 0s., 10h. 47m. 0s., and 10h. 49m. 0s. have just been transmitted from the Eiffel Tower, then there follow immediately after them the weather signals. It may be mentioned again that the signals are sent through quite slowly, so that with a little practice they can be easily recorded and deciphered.

A typical message received in London on January 28, 1913, ran as follows:

(a) =BCM=R.51000=V.491424=O.551633=
C.621812=H.653043=S.46207=
Pression basse ouest Europe élevée nord==

(b) R.51000=V.491424=O.551633=
C.621812=H.653043=S.46207=
Pression basse ouest Europe élevée nord=

(c) Paris=vent 9 mètres stationnaire sud croît pression 758 stationnaire ciel couvert==

(d) V. 9 m ss sud cc pp 758 ss ciel couvert

Then follow the signals:

·–·–· (end of transmission).

··–· ·–·· (FL repeated several times, which denote Eiffel Tower).

And lastly

···–·– (end of work).

The above message has been divided into four sections and marked (a) (b) (c) (d), in order to show that (b) is simply a repetition of (a), and that (d) is a repetition of (c), only sent in brief, *i.e.* "V" corresponds to "vent," "m" to "mètres," "ss" to "stationnaire," &c.

In deciphering the message only (a) has to be considered, because (c) explains itself, being the

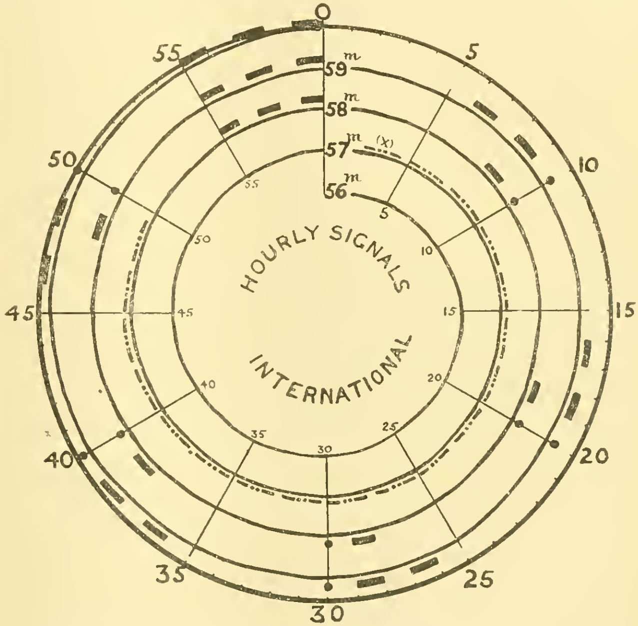


Fig. 1.—Diagram to illustrate the international system of radio-telegraphic time signals which will come into operation on July 1 of this year.

general weather conditions at Paris stating the velocity of the wind in metres per second, direction of wind, pressure in millimetres, and state of sky. At 3 p.m. each afternoon a similar message stating the meteorological conditions at Paris is transmitted from the Eiffel Tower.

With reference to (a), then, the message contains information relating to (1) atmospheric pressure, (2) wind direction and force, (3) the state of the sea, *in code* from the following six stations: Reykjavik (R), Valencia (V), Ushant (Ouessant) (O), Corunna (C), Horta (H) (Azores), for 7 a.m.; and for St. Pierre (S) (Miquelon, Newfoundland) for the preceding 8 a.m. (see Fig. 2).

The coded part of the message is given in seven groups. The first group, BCM, stands for the Bureau Central Météorologique, and indicates the source of the information. The above-named stations are indicated by the single letters printed in brackets above.

FIG. 2.—Chart showing the positions of the stations neighbouring the North Atlantic, the meteorological conditions at which are daily transmitted by radio-telegraphy from the Eiffel Tower. (See text for names of stations indicated.)

The first two figures in each group indicate the barometric pressure in millimetres, it being understood that 700 mm. should be added. The next two figures represent the wind direction in points of the compass as follows:—

Code No.	32	02	04	06	08	10	12	14	16	18	20	22	24	26	28	30
Direction	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW

The fifth figure denotes the wind force on a scale ranging from 0, a calm, to 9, a hurricane. The sixth and last figure shows the state of the sea, a "calm" being denoted by 0 and "tremendous" by 9.

In the case of Reykjavik and St. Pierre, the sixth figure is omitted, no reports for transmission being available.

It sometimes happens that when the messages are being sent out from the Eiffel Tower, some of the data for some of the stations have not been received by the Bureau Central Météorologique, and therefore cannot be transmitted. In these cases the signal -..- or X is substituted for any unknown figure.

The following statement gives a full translation of the message marked (*a*) given previously, the code letters and figures being given in the first, third, fifth, seventh, and eighth columns.

Bureau Central Météorologique.

Letter	Station		Barometer mm	Wind Direction		Wind Force Scale 0–9	Sea Scale 0–9
R	Reykjavik	51	751	00	N	0	—
V	Valencia	49	749	14	SSE	2	4
O	Ouessant (Ushant)	55	755	16	S	3	3
C	Corunna	62	762	18	SSW	1	2
H	Horta (Azores)	65	765	30	NNW	4	3
S	St. Pierre	46	746	20	SW	7	—

Low pressure west Europe high to the north.

It is impossible to overestimate the great value such messages can be to outward and homeward bound ships that receive them, for instead of having to gauge the approaching weather conditions from their own isolated observations they can form a far more accurate judgment by the deductions from the radio-telegraphic data.

While the distribution of time and weather signals will be of general utility, perhaps its most important value will be felt by sailors. Cut off from all shore communication with the exception of wireless, they will be put on nearly the same equality as land stations when the international system is in full swing.

WILLIAM J. S. LOCKYER.

NOTES.

IN the King's Speech at the opening of Parliament on Monday reference was made to the following matters, among others, to be brought forward during the session:—A guarantee from the Imperial Exchequer of a loan by the Government of the Sudan for the development therein of the industry of cotton-growing; proposals for the better care and control of the feeble-minded and for the further restriction of the industrial employment of children; proposals for the development of a national system of education. In the course of his comments upon the last-named subject, Lord Crewe remarked, in the House of Lords, that it is not the intention of the Government to endeavour to force through Parliament in this session a vast measure dealing with national education. "But in view of what has fallen from the Prime Minister, and also in view of the observations made by the noble and learned lord on the Woolsack at Manchester in the beginning of January, which were the sequel to a close inquiry into the subject, we think it is quite proper to place the country in possession of the general lines of our intentions during the coming session, although I do not suppose that we shall be able to proceed very far towards getting them carried into law. We have not embarked on the consideration of the question without counting the cost or without realising that it will be necessary to provide more than is provided at present out of national funds towards the cost of education."

Dr. Dugald Clerk, F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public services."

The Trustees of the Indian Museum have appointed Dr. N. Annandale as their representative at the International Congress of Zoology, to be held at Monaco this month.

The ninth International Physiological Congress will be held at Groningen on September 2–6 next, under the presidency of Prof. H. J. Hamburger, professor of physiology in the University of Groningen.

Mr. David S. Prentice, superintending inspector, has been promoted to the post of chief inspector of the veterinary branch of the Department of Agriculture and Technical Instruction for Ireland.

The death is announced at Paris, at sixty-nine years of age, of M. A. M. Picard, vice-president of the Council of State and an honorary member of the Institution of Civil Engineers. M. Picard was the author of several works on engineering subjects, and many comprehensive reports upon the achievements of arts and industry at the close of the nineteenth century and after.

At a meeting of the council of the British Association, held on March 7, a vote of condolence with Lady White on the death of Sir William White, president-elect of the association, was passed. The presidency for the forthcoming meeting in Birmingham was considered, and subject, under the rules, to ratification at an extraordinary meeting of the council, to be held on April 4, Sir Oliver Lodge, F.R.S., will be nominated as president. There will be a meeting of the general committee on the same day to make the election.

America has lost a bacteriologist of great promise by the death, in his forty-fifth year, of Dr. P. H. Hiss, jun. After graduating in arts at Johns Hopkins and in medicine at Columbia, he was appointed in 1895 assistant in bacteriology at the College of Physicians and Surgeons at Columbia University. From that post he was promoted successively to an instructorship, adjunct professorship, and, in 1906, to the full professorship in that subject. Dr. Hiss was joint author of a widely used text-book of bacteriology, and had also published a series of technical studies. He was best known by his methods of detecting typhoid bacilli, and by his use of the leucocyte as a cure for pneumonia and erysipelas.

A marble bust of the late Mr. Brian Houghton Hodgson, executed by Thornycroft in 1844, has been presented by his widow to the British Museum (Natural History). The bust, of which a photograph is given in Sir W. W. Hunter's "Life of Hodgson," represents Hodgson, who died in 1894, at the age of forty-four. By the gift of his natural history and anthropological collections made while British Resident at Khatmandu, in the first half of last century, and subsequently while living privately at Darjiling, Hodgson greatly enriched the museum, and it is therefore appropriate that his bust should find a home in the building, where it is to be placed, we believe, alongside that of Dr. Gray, at the entrance to the Upper Mammal Gallery.

The Franklin Institute, Philadelphia, acting through its committee on science and the arts, recently made the following awards of the Elliott Cresson gold medal, the highest in the gift of the institute:—Dr. C. P. Steinmetz, of Schenectady, New York, in recognition of successful application of analytical method to the solution of numerous problems of first practical importance in the field of electrical engineering; Emile Berliner, of Washington, D.C., in recognition of important contributions to telephony and to the science and art of sound-reproduction; Dr. I. Randolph, of Chicago, Ill., in recognition of distinguished achievement in the field of civil engineering; Lord Rayleigh, O.M., in recognition of extended researches of signal importance in physical science; Sir William Ramsay, K.C.B., in recognition of numerous discoveries of far-reaching importance in the science of chemistry; Prof. Emil Fischer, of Berlin, in recognition of numerous contributions of fundamental importance to the science of organic and biological chemistry.

One of the largest of the great scientific and industrial congresses is to be held in London in the early part of June, 1915. This is the sixth International Congress of Mining, Metallurgy, Applied Mechanics, and Practical Geology. These congresses take place at intervals of five years, and the last, which was brilliantly successful, was held at Düsseldorf in 1910, previous congresses having been held in Paris and Liége. The attendance at the Düsseldorf Congress was more than 2000, and it is anticipated that the attendance in London in 1915 will be equally large. An influential committee has been formed to make the necessary arrangements, and the movement is being actively supported by the University of London, Imperial College of Science and Technology, Geological Society of London, Institution of Mechanical Engineers, Iron and Steel Institute, Society of Chemical Industry, Institution of Mining Engineers, Institution of Mining and Metallurgy, Institute of Metals, South Wales Institute of Engineers, Cleveland Institution of Mining Engineers, West of Scotland Iron and Steel Institute, Staffordshire Iron and Steel Institute, Sheffield Society of Engineers and Metallurgists, and by numerous firms interested in the various industries represented.

The winter, as comprised in the period for the thirteen weeks ended March 1, is shown by the Meteorological Office to have been mild, wet, and somewhat sunless over the entire area of the United Kingdom. The excess of temperature was greatest in the south-east of England, where the mean for the period was 3° above the average. In the Midland Counties and in the east of England the mean temperature was 2·5° above the average. The heaviest rainfall for the winter was 14·90 in. in the west of Scotland, which was followed by 14·70 in. in the south of Ireland, and 14·58 in. in the south-west of England. The greatest excess of rain was 32 per cent. above the average in the south-west of England, and about 25 per cent. in excess in the Midland Counties, the south-east of England, and in the north and south of Ireland. The sunshine for the winter was sixty hours deficient in the east and west of Scotland, but only about twenty hours deficient in the south-east of England. The temperature for the winter of 1911–12 was about equally in excess to that of the recent winter. The excess of the rainfall was everywhere greater except in the north of Scotland, where in 1911–12 there was a deficiency. In the south-west of England the aggregate rainfall in the winter of 1911–12 was 16·36 in., which was 5·29 in. more than the average. The duration of bright sunshine was also everywhere deficient in the winter of 1911–12, except in the north of Scotland. The characteristics of the last two winters were very similar over nearly the whole of the United Kingdom.

THE ninth International Zoological Congress will be held at Monaco, under the presidency of H.S.H. the Prince of Monaco, from Tuesday, March 25, to Saturday, March 29. The congress this year appears to be specially attractive, there being up to the present time above 500 members who have enrolled. Besides special communications which are to be made in the seven sections of the congress, questions of general interest will be discussed at the early meetings. One point the zoologists are specially asked to discuss, and in some way agree upon, is concerning the use of generic and specific names, as to whether in all cases zoological nomenclature should be given absolutely to the original generic and specific name, or whether exception should be made in certain time-honoured generic and specific names which are thoroughly familiar to every zoologist. No lengthy excursions are arranged, but there will be receptions held at the Oceanographical Museum, at the palace, and in other places in the principality. Included in the programme is a fête performance at the opera. The fee for attendance is 25 francs, and application should be made at an early date for particulars regarding hotel accommodation, &c., to the secretary, whose address until March 15 is Prof. Joubin, Oceanographical Institute, 195 Rue Saint-Jacques, Paris, and afterwards the Oceanographical Museum, Monaco.

IN the February issue of *Man* Messrs. M. Longworth Dames and T. A. Joyce describe a remarkable steatite relief acquired by the British Museum from the Swat Valley, on the north-west Indian frontier. It represents in a most artistic way the famous story of King Sivi, who saved a pigeon from a hawk, and to compensate the pursuer cut off pieces of his own flesh equal in weight to the bird. This is the only known representation of the story, and the acquisition of the relief is particularly interesting because, according to the Chinese Buddhist pilgrim, Hiouen Tsang, Asoka built a stupa in the land of Udyāna, the modern Swat Valley, to commemorate this incident. The discovery of the relief will now probably give a hint as to the position of the stupa. The writers point out that this story is also localised in the Indus Valley, and, being imported into Europe, was possibly the origin of the legend which formed the basis of "The Merchant of Venice."

REFERRING to Prof. R. T. Hewlett's article on the pasteurisation of milk, published in our issue for February 6 last (vol. xc., p. 623), "Paterfamilias" sends an account of a method of preserving milk he has found successful. The plan, which Prof. Hewlett considers very good, was to put the milk in an earthenware bottle with narrow neck, and to keep the bottle in a boiling water bath for twenty or thirty minutes, according to the size of the bottle. While still in the bath, a rubber stopper with a thistle funnel stuffed with cotton-wool was inserted in the neck and the bottle removed. As pointed out, however, in Prof. Hewlett's article, even with the precautions adopted by "Paterfamilias," in hot weather, unless *cooled* after treatment, the milk is liable to undergo very undesirable changes.

WE have been favoured with a cutting from *The Daily Malta Chronicle* of February 17, in which Mr. N. Tagliaferro, who has for some time been collecting fossil bones from a rock-fissure at Corradino, records the discovery of a large series of remains of giant land-tortoises. Most of these, it is stated, are referable to *Testudo robusta*, and the smaller *T. spratti* of Leith Adams. One of the specimens is, however, asserted to indicate a tortoise nearly half as large again as the biggest described example of the former, and may, it is suggested, represent a third species. These and other remains have been deposited in the museum at Valletta, and will, no doubt, be fully described in due course.

IT is announced in the Proceedings of the Philadelphia Academy for December, 1912, that the work of rendering the library and museum fireproof, which was undertaken through the aid of the Commonwealth of Pennsylvania, has at length been completed. As the library of natural history works is stated to be the largest in America, while the museum is particularly rich in type specimens, the importance of the achievement can scarcely be overrated. New quarters have been prepared for the entomological department, which are stated to meet all the requirements of workers; the department is devoting special attention to the economic aspects of entomology and the etiology of diseases due to insects.

IN the *Naturwissenschaftliche Wochenschrift* (xii., 5, February 2, pp. 65–69) Mr. H. Nachtsheim gives a valuable summary of observations and experimental work on the reproductive cycle of Rotifers. Most of the work has been done on *Hydatina senta*, and the greater part of his paper deals with this species. He reviews the earlier work of Maupas and Nussbaum, shortly summarises that of Punnett, and then discusses at greater length the experiments of Whitney and A. F. Shull, who have sought to determine what are the intrinsic and extrinsic factors which bring into existence male-producing and female-producing parthenogenetic females. It is concluded that while in many Rotifers, as Lauterborn has shown, there is a fairly regular cycle, in Hydatina external conditions, especially the chemical condition of the water, have much greater effect, perhaps because Hydatina lives in small pools which are more readily affected by environmental factors. Little is said about cytological observations, and the work of Lenssen, which is probably only in apparent contradiction of the later observations of Whitney, is not mentioned. Otherwise it appears to be a very complete and compact summary of our present knowledge of the subject.

Prof. G. Klebs has forwarded a reprint of his recent important paper (*Verhandl. d. nat.-med. Ver.*, Heidelberg, 1912) on the morphology and phylogeny of the Peridineæ, a group of Protista which has in recent years received a vast amount of attention on account of the important part which these organisms play in the phytoplankton of both salt and fresh water. In this paper the author describes a number of new genera which are of remarkable interest as connecting up the typical Peridineæ with the Flagellate group Cryptomonadina, and showing also that on the other hand the Peridineæ have apparently given rise to Alga-like forms characterised by gradual loss of motility, and the development of resting colonies showing vegetative cell-division. He also discusses the possible affinities between the Peridineæ and certain groups of Algæ (Diatomeæ, &c.), and of Protozoa (*Infusoria ciliata* and Radiolaria), and represents his views in a diagrammatic "family tree."

The last number of the Bulletin of the Seismological Society of America contains two short accounts by Mr. G. A. Clark and Mr. A. G. McAdie of the eruption of the Katmai volcano in Alaska last June (vol. ii., pp. 226–229, 236–242). The volcano is a rather insignificant peak, less than 5000 ft. in height, and, before last June, was supposed to be extinct. The eruption began on June 6 at about 4 p.m., and was seen by several observers on the island of Kodiak, at a distance of seventy-five miles. A heavy fall of ashes took place during June 6 and two following days, but ceased about three days later. The town of Katmai, which was explored on June 14, was found to be buried in ashes to a depth of three or four feet, and on Kodiak island the thickness of the layer of ashes was more than a foot. Further eruptions occurred during each of the next four months, those of August 19 and October 25 being of some violence.

The useful report on the state of the ice in the Arctic seas during 1912, published by the Danish Meteorological Institute, is of more than usual interest in view of the abnormal conditions which obtained in the North Atlantic in that year. It includes, as before, monthly summaries prepared from all reports received, and charts showing the condition of the ice during each of the months April–August. The winter of 1911–12 was on the whole mild in the region of Bering Strait and in Greenland, but cold in the European Arctic seas; in the White Sea there was much ice until the first half of June, and the Kara Sea seems to have been unapproachable all through the summer. In Barents Sea the edge of the ice throughout the summer was more westerly and southerly than usual. The coast of Iceland was quite free during the year, but the edge of the ice was not far off the northern shore. Vessels were able to put into Angmagsalik (East Greenland) about the third week in July, owing to there being no great drift southward of the vast masses of ice further north; a possible result may be a heavy drift this year. The conditions along the west coast of Greenland were about normal. Only few reports from Bering Sea and Strait were received, and none from the Beaufort Sea. On this account the institute makes an impressive appeal for more cooperation in its important work; during the year in question the available information was almost entirely received from Norwegian and Danish sources. The proposed publication by the Meteorological Office in its *Weekly Weather Report* of observations respecting the state of the ice off the east coast of North America during this season, received by wireless messages from the whaler *Scotia*, which has been chartered by the Board of Trade in conjunction with the North Atlantic steamship lines, will be an important step in the direction of the appeal of the Danish Meteorological Institute.

From the *Rendiconti* of the Royal Lombardy Institution we learn that the prize for airships, which was founded by the late Dr. Cagnola long before the days of aërial navigation, has again been unawarded, as has, indeed, been the case during practically the whole period of development of modern airships and dirigibles. The report of the referees on the work submitted by the solitary competitor, coupled with the absence of other competitors, seems to indicate that Italian aëronauts, as well as others competent to submit Italian, French, or Latin accounts of their successful experiments, are deterred from making any serious effort to compete for the prize, and this for some reason or other which is doubtless well known to them. The object which Dr. Cagnola had in view has been attained quite independently of his benefaction, and it is surely unfortunate that the latter has signally failed to further this end.

Postage stamps do not often afford material for scientific discussion, but an interesting point is mentioned by Mr. Sam S. Buckley in his book on the marginal varieties of the Edwardian stamps of Great Britain (published by Oswald Marsh, London), in connection with a change that was initiated in the autumn of 1911 in the mode of perforating the new English issues. Until then the horizontal and vertical perforations were at the same distance apart, namely 14 in 2 centimetres. It was found, however, that the stamps would not tear well along the horizontal lines, and the explanation was that in machine-made paper the fibres have a tendency to lie in certain directions, thus making the resistance to tearing unequal in different directions. A remarkable result of these experiments was the conclusion that the resistances could be equalised by using fifteen perforations horizontally to fourteen vertically, the extra perforation making all the difference.

We have received a copy of a new illustrated catalogue of physical apparatus issued by Messrs. F. E. Becker and Co., Hatton Wall, E.C. It is a substantial quarto volume of more than a thousand pages, and covers most of the apparatus, from millimetre scales to electric motors, likely to be used in a physical laboratory, while the requirements of the engineer and miner are not forgotten. Some of the newer apparatus is described in detail, and instructions as to its use are given, as, for instance, in the case of the Bunsen ice calorimeter on p. 950, and of the stereo pyrometer on p. 1013.

The first number of *Scientia* for 1913 contains two articles which throw doubt on the validity of the recently discovered sun-spot periods of five and eight years, and on the principle of relativity which has taken so prominent a place in recent theory. The first article is by Mr. E. W. Maunder, of Greenwich. The second article, by Prof. M. Brillouin, of the Collège de France, points out the slenderness of the foundation on which the theory of relativity has been reared, and maintains that the impossibility of detecting a relative motion of ether and matter, which forms the basis of the theory, is merely an experimental difficulty of the present time, and ought not to be elevated into a universal principle. Prof. Brillouin also takes exception to some of the more recent propositions stated by Prof. Einstein, as, for example, that energy has inertia and weight, and concludes that the principle of relativity introduces more difficulties than it solves.

The *Verhandlungen* of the German Physical Society for January 15 include a short *résumé* by Dr. F. Reiche of the results he has obtained for the distribution of intensity in a fine spectrum line under various conditions. He considers a thin layer of a luminous gas the electron systems attached to the atoms of which are oscillating owing to the impact on them of electrons or atoms. The breadth of the line emitted is produced partly by damping due to radiation, and to inter-atomic forces, and partly to the motion of the emitting centres themselves in accordance with the kinetic theory of gases. As a result, he finds that the distribution of intensity is to a great extent determined by a parameter, which, if small, gives the distribution found previously by Lord Rayleigh; if large, a distribution the author proposes to call the "dispersion distribution." In the former case, increase of density of the gas or of thickness of the layer of gas leads to only a small amount of widening of the line, in the latter to a considerable widening. These theoretical conclusions have been verified experimentally.

A year ago reference was made in Nature to the elegant proof given by Willstätter and Escher that lutein, the yellow pigment of yolk of egg, was similar to, if not the same as, the xanthophyll present in leaves. In the interval other animal pigments have been investigated, and Dr. Escher now announces that the yellow pigment of the *Corpus luteum* is identical with carrotene, such as is present in carrots and leaves, and closely allied to lycopin, the colouring matter of tomatoes. Carrotene has been shown by Monier-Williams to form the yellow colouring matter of wheaten flour, and it is of interest to note that Escher states he has preliminary evidence that the yellow pigment of fat is similar in composition. Carrotene is an unsaturated hydrocarbon, $C_{40}H_{56}$, whereas xanthophyll has the formula $C_{40}H_{56}O_2$. The two classes of pigments are separated by shaking with a mixture of alcohol and light petroleum. The liquid forms two layers, the upper one of petroleum ether containing the carrotene, and the lower alcoholic layer containing the xanthophyll. The ovaries of no fewer than 10,000 cattle were required for the investigation, and yielded less than half a gram of pigment.

Five recent additions to the "Cambridge Manuals of Science and Literature" have been received from the Cambridge University Press. One volume, by Prof. J. H. Poynting, has on its cover, "The Earth," but an examination of the title-page shows that its shape, size, weight, and spin only are dealt with. In Mr. A. J. Berry's book, "The Atmosphere," the subject-matter has been restricted to the more purely chemical and physical phenomena, meteorology being omitted. Dr. Alex. Wood writes on "The Physical Basis of Music," and provides an elementary account of the principles of the subject. In "The Story of a Loaf of Bread," Prof. T. B. Wood gives a popular account of the subject so far as farming, milling, and baking are concerned. Mr. E. L. Attwood, writing from the naval architect's point of view, contributes a volume on "The Modern Warship." The volumes, which are each sold at 1s. net, appear to be addressed to the general reader, but it is to be feared that few such readers will be prepared to give the sustained attention which the treatment of the subject in most of the volumes demand. In accuracy and authoritativeness the books leave nothing to be desired, and as introductions to more advanced treatises the series may be recommended unreservedly.

A brief account of the thirteenth meeting of the Australasian Association for the Advancement of Science, held in January, 1911, at Sydney, appeared in the issue of Nature for February 23, 1911 (vol. lxxxv., p. 558). We have now received the official report of this meeting, edited by the permanent honorary secretary, Mr. J. H. Maiden, assisted by the secretaries of sections. It is an imposing volume of 766 pages, and is well and profusely illustrated with forty-eight plates, in addition to the illustrations in the text. The report provides excellent evidence of the industry and enthusiasm of Australasian men of science, and of this record of a year's work the association may well be proud.

OUR ASTRONOMICAL COLUMN.

The Use of a Plane Grating in Stellar Spectroscopy.—In No. 5, vol. vi., of the Journal of the Royal Astronomical Society (Canada) there is an interesting note describing some preliminary tests, made at the Dominion Observatory, Ottawa, of a plane grating used as the dispersion piece of a stellar spectrograph. The grating used is one ruled by Dr. J. A. Anderson, who is now regularly ruling excellent gratings at the Johns Hopkins University, and has a ruled surface of $2\frac{5}{8} \times 3\frac{3}{4}$ in., with 15,000 lines to the inch. It was employed in the Littrow form of spectrograph, giving a linear dispersion of 17·5 Angströms per millimetre, and gave excellent definition over a nearly flat field extending from $\lambda 4800$ to $\lambda 3500$. The photographs secured show a much more uniform intensity over a wide range than do those taken with a three-prism spectrograph, and for this reason will be especially useful. In the red, where the prismatic spectrum is so compressed, and in the violet and ultra-violet, where it suffers considerable absorption, the grating spectrograph will prove very advantageous, and the results of the further experiments to be made will be awaited with interest.

Observations of the Zodiacal Light.—The February number of *L'Astronomie* contains two striking drawings of the zodiacal light as seen by Lieut.-Col. Pachine at Essentouki (Caucasus) on January 28, 1911. This observer has seen the phenomena many times, and in various countries, but had never before seen it so bright. At 6h. 30m. p.m., the base of the luminosity extended along the western horizon for a distance of some 30° from α Piscis Austr. towards Aquila, and the cone reached upwards to a point a little to the south of α Arietis, the brightness from the base to γ Pegasi being more than twice that of the Milky Way in its brightest parts. Many curious fluctuations took place, and at 9h. 40m. the apex of the cone enveloped the Pleiades. The colour of the light generally was from a pale-yellow to a bluish-grey.

Astronomical Time-installations.—A brochure published by the Royal Observatory of Belgium contains a very detailed and well-illustrated account of the installations employed for the time-service in that observatory, written by MM. Philippot and Delporte. The various means employed to secure the necessary constancy of pressure and temperature in the underground chamber containing the installation are very interesting, as are also the various devices for automatic regulation and registration, and it would appear that the Belgian authorities have established an ideal installation for their time-service.

Amateur astronomers will find a useful note, by M. Jonckheere, in the January number of *L'Astronomie*, describing a device he employs for keeping his sidereal clock at constant temperature. The clock is placed in a double case, and should a change of temperature occur, a current is sent automatically through a heating circuit (an incandescent lamp bulb) until equilibrium is restored. With this apparatus M. Jonckheer keeps the temperature constant within 0·25° C.

ORNITHOLOGICAL NOTES.

In the fifth part (vol. i.) of *The Austral Avian Record* the editor executes a complete *volte face* in the matter of the classification of Australian birds. Hitherto he has used generic terms in a wide and comprehensive sense; he now employs them in a much more restricted signification, and accordingly proposes no fewer than forty-eight new genera in this issue. Whether such changes be expedient or not (there is no right or wrong in the matter), they have the great disadvantage of rendering standard works, like Sharpe's "Hand-list of Birds," more or less obsolete.

In *The Zoologist* for December, 1912, Mr. F. J. Stubbs gives reasons for regarding migration as a cosmical function, which plays an important part in regulating the present balance of life on the globe. The prevalence of continuous sunlight during the Arctic summer and its absence in winter is regarded as the primary controlling factor of the phenomenon.

Bird-migration in Lindisfarne forms the subject of an editorial article in *British Birds* for December, 1912. Rather more than a hundred kinds of birds were observed on the island, of which not more than thirty seemed to be resident. Although no great inrush of birds was noticed, migration was going on during twenty-six out of the forty days of the visit. Bird-life in the south-west of Ireland and the recovery of birds marked in 1912 form two of the chief items in the January issue of the same journal.

Bird-marking in the Netherlands forms the subject of an article by Dr. E. D. Van Oort in Notes Leyden Mus., vol. xxxiv., p. 243. The number of birds marked in 1912 was considerably greater than in the preceding year. The record includes such birds of both years as have been recovered up to date, but the returns from correspondents were not complete when the article was written.

In the course of a narrative of a trip through South America, including a visit to Tierra del Fuego, which deals chiefly with ornithology, Mr. F. W. Blaauw (Notes Leyden Mus., vol. xxxv., No. 1) describes the nestling plumage of the so-called Coscoroba swan (*Coscoroba candida*), and its bearing on the affinities of the genus. The colour-pattern is intermediate between those of sheldrake and tree-duck chicks, the head-markings approximating to, and the body-markings being almost identical with, those of the latter. This tends in some degree to confirm the author's view that Coscorobas are practically overgrown tree-ducks.

It is satisfactory to learn, from a report by Mr. G Bolam on the natural history of Hornsea Mere, published in the January number of *The Naturalist*, that the local birds are most efficiently protected by the keeper, who has occupied his post for thirty-two years. It may be noted that in 1911 fourteen bearded tits were introduced, some of which have nested and reared young.

In a long article on the "Hand-list of British Birds," by Dr. Hartert and others, published by Messrs. Witherby, *The Field* of March 8 strongly condemns the great changes in familiar nomenclature which form one of the most striking features in that work, referring especially to the inconvenience caused by transferring names long associated with well-known species to others. At the conclusion of the article it is suggested that those "who may be in doubt whether to accept or reject the list now under consideration will do well to await the appearance of a new edition of the B.O.U. List, which, we understand, is in active preparation. The simplest way out of the difficulty, as it seems to us, is to ignore the new list."

Last year schedules were distributed throughout the country with the object of obtaining data with regard to the alleged decrease during the last few years in the numbers of certain migratory species which regularly visit the British Islands. Although the returns are not so full or so numerous as is desirable, they afford a considerable amount of information in respect to England, which is summarised by Mr. M. Vaughan in the March number of *British Birds*. As the result of the inquiry it seems practically certain that a decrease—and this not merely local—has taken place in the case of several species, notably the whitethroat, the redstart, the marten, the swallow, and the wryneck. No attempt is made to explain the diminution in numbers, which we have heard attributed, at least in the case of some species, to shooting and netting on the Continent.

In the February number of *The Zoologist* Mr. J. M. Dewar records further observations on the manner in which oyster-catchers open mussels and other bivalves. Mussels seldom open their shells wide enough to enable the bird to introduce its beak, except by the way of the gap for the byssus, and when this is not accessible, the oyster-catcher resorts to careful tapping, which causes the mollusc to rotate one valve on the other, and thus afford an entrance for the beak. Small mussels are frequently hammered to pieces by repeated blows with the beak.

Nos. 6 and 7 of *The Austral Avian Record* are devoted to a list of the species of Australian birds named by John Gould, and the present location of the type specimens, drawn up by Messrs. Witmer Stone and Mathews. The Gould Australian collection was sold in 1847 to Dr. T. B. (not J., as has been stated) Wilson, of Philadelphia. The type specimens are for the most part in the museum of the Philadelphia Academy; although the greater part of those of species named by Gould subsequently to the 1847 sale are in the British Museum. Gould named 426 or 427 Australian birds (both numbers are given at the end of the list) of which 341 stand, either as species or subspecies. The list will be valuable to systematic ornithologists.

In his presidential address to the Royal Australasian Ornithologists' Union, as reported in *The Emu* of January, Mr. J. M. Mellor emphasised the necessity of continued bird protection and the working of the present Act. A serious defect in this is the opportunity afforded by merely partial protection for a heavy destruction of certain species during the Christmas holidays.

In *Science* of February 27, Dr. R. W. Shufeldt announces a forthcoming memoir on the Pleistocene avifauna of the Oregon desert, in which three extinct species will be described. R. L.

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RECENT ADVANCES IN SCIENTIFIC STEEL METALLURGY.[1]

TO render clear the exact nature of certain modern scientific advances in steel metallurgy it is necessary briefly to consider what is known of the past history of steel, more particularly with reference to cutting implements, whether for the purposes of peace or war. That steel (or, to be more accurate, probably steely-wrought iron) was known to the ancients, say, 3000 years ago, seems to be proved by a passage translated by Pope from the ninth book of Homer's "Odyssey":—

"And as when armourers temper in the ford
The keen-edged pole-axe, or the shining sword,
The red-hot metal hisses in the lake
So in his eyeballs hissed the plunging stake."

As has been truly remarked by Roscoe and Schorlemmer, the above description can be applied only to steel—that is to say, to iron containing a very considerable percentage of carbon.

So far as definite records are concerned, the story of early British steel metallurgy is wrapped in profound obscurity, and its history can be only indirectly surmised from collateral historical evidence. About A.D. 60 a great British army under the command of Queen Boadicea stormed the Roman camp at Colchester and annihilated the Ninth Legion. She then marched on St. Albans and London, and in both places put the garrisons and the Roman colonists to the sword, the stake, or the cross. Tacitus, the Roman historian, records that the losses of the Romans and their allies in these battles reached the startling total of 70,000 people. In the subsequent campaign, which ended in the defeat and death of the heroic British Queen, the same historian states that the British lost 80,000 persons.

It is evident, therefore, that Boadicea must have commanded at least 100,000 British troops, or she could never have undertaken such extensive and formidable military operations. It is also clear that these troops were armed with swords and spears, to say nothing of the scythes attached to the axles of their war chariots. There is no reason to suppose that these weapons were not of native manufacture. They would partly be made of bronze and partly of steely-iron, since the country had been for a century occupied by Roman soldiers and artisans. It is therefore almost certain that in the first century the manufacture of steely-iron weapons and implements would be on a fairly large scale, and would doubtless mainly be concentrated in iron ore and charcoal-producing districts, such as Sussex and the Forest of Dean.

In connection with Sheffield—now the greatest British steel centre—the earliest written record refers to the twelfth century, and states that in 1160 the monks of Kirkstead Abbey had somewhat extensive works at Kimberworth, near Sheffield, manufacturing wrought-, and, no doubt, steely-irons. In 1386 Chaucer, in "The Reve's Tale," in describing a miller of the time of Edward III., wrote, "A Shefeld thywtel bare he in his hose." Since 1386 Sheffield steel in the form of table knives has been in almost everybody's mouth. In 1590 Peter Bales, "The Writing Schoolmaster," recommends Sheffield razors and penknives for the cutting of quill pens. It is obvious that for this purpose fine steel carrying a perfect cutting edge is necessary, and was being made at Sheffield prior to 1590. Hunter states that in 1615 Sheffield workmen could make armour only fit for the common man-at-arms. The armour for knights was imported from Spain and Italy. Scott, in "Ivanhoe," embodies this fact in his description of the siege of "Torquilstone":—

"Thrice did Locksley bend his shaft against De Bracy, and thrice did his arrow bound back from the Knight's armour of proof. 'Curse on thy Spanish steel coat,' said Locksley. 'Had English smith forged it, these arrows had gone through an as if it had been silk or sendal.'"

The opening scene in "Ivanhoe" was near Woodhouse (five miles east of Sheffield), where, until quite recently, wrought-iron was manufactured at the Rotherwood Iron Works.

In 1760 Horace Walpole, writing to George Montague, remarks: "I passed through Sheffield, which is one of the foulest towns in England in the most charming situation. There are two-and-twenty thousand inhabitants making knives and scissors. They remit eleven thousand pounds a week to London. One man there has discovered the art of plating copper with silver. I bought a pair of candlesticks for two guineas, that are quite pretty."

Antiquarians express the opinion that the remarkable concentration of the cutting-steel industry round Sheffield was due to the juxtaposition of coal and iron ore in the district. This reason, however, is quite unconvincing to metallurgists; first, because charcoal and not coal was used, and, secondly, because the local ore produces an iron high in phosphorus, from which it is practically impossible to make cutting implements of fine steel. There is little doubt that the main factor which originally determined the location of the chief British steel industry at Sheffield was the unique situation of the town in a hollow near the confluence of four rivulets into the Don. Along these streams, running down the valleys of the Sheaf, the Porter, the Rivelin, and the Locksley, the old Sheffield steel-workers could, by the construction of numerous dams, get water-power for their forging hammers and grinding wheels at a small cost, and waterwheels worked by some of these dams are still in operation along these valleys, that of the Don itself actuating tilt-hammers and grindstones.[2] The latter are made from the carboniferous sandstones of the district. There is proof positive that the basis metal, consisting of nearly pure iron, from which the best Sheffield cutting steels are still made, was being imported into the town in the sixteenth century from abroad.

Among entries in the accounts of the Sheffield Church burgesses for the year 1557 is the following:—

"Paid to Robert More for one stone and quarter of Danske Yron XXIId. Paid to ye same Robt. for X lib of Spanysche Yron XV."

In modern money the cost of this raw material works out to at least 60*l.* per ton, or 3*l.* per cwt.[3] The Danish (Danske) iron was probably Swedish, just as at present much of the Danish butter imported comes from Swedish dairies.

In connection with the early importation of pure Swedish or Spanish iron for a basis metal, it is significant that in 1442 Sheffield obtained a Royal warrant to construct towpaths to make the River Don navigable. This river runs into the Humber at Goole, and there is little doubt that so early as the fifteenth century Sheffield steel-makers were endeavouring to replace the costly packhorse transit of foreign raw

[1] Discourse delivered before the Royal Institution on Friday, January 24, by Prof. J. O. Arnold, F.R.S.

[2] There is evidence in old documents that the name Sheffield may be a corruption of "Escafeld," meaning "the field of waters."

[3] Prof. Thorold Rogers in his Oxford lectures, 1888–9, stated that about 1685, using a multiplier of 2, the value in modern money of English wrought-iron was about 73*l.* per ton. The Sheffield record, however, proves beyond doubt that in 1557, *or more than a century and a quarter earlier*, the imported and superior Spanish and Swedish irons were commanding in Sheffield, retail, not more than 14*l.* per ton, which, using a multiplier of 4.5, is equivalent in present money to 63*l.* per ton.

materials by cheaper water carriage from the Humber.

It is next of interest to consider how, during the fourteenth, fifteenth, sixteenth, seventeenth, and half the eighteenth centuries, Sheffield made all its fine steel. It seems almost certain that the nearly pure imported Swedish or Spanish irons were carburised "in the dry way," by cementation in charcoal at a yellow heat. The highly ductile bar iron and the blistered and brittle steel resulting from its cementation-carburisation were described. The blister bar was then made into what for perhaps two hundred and fifty years has been known as "shear steel."

(The method of producing from blister bar both single and double shear steel was then described.) The origin of the name "shear steel" was due to the fact that British cloth-workers insisted on having this fine quality of steel for their cloth-cutting shears, and this material is still branded with rude representations of clothiers' shears. One pair of shears signifies single shear and two pairs double shear steel. The chemical composition of this steel, which is the purest made, is as follows:—Carbon 1·00 per cent; silicon, 0·03 per cent.; manganese, 0·07 per cent.; sulphur, 0·01 per cent.; phosphorus, 0·015 per cent. With its high reputation built up during centuries this material has naturally had its name branded on inferior kinds of steel. Indeed, bars of steel up to 6 in. in diameter have been sold as "shear steel" at 18*s*. per cwt., the price of the raw material from which shear steel is manufactured. Probably a bar $1\frac{1}{2}$ in. in diameter marks the advisable limit of size for genuine shear steel, and its average market price is about 45*s*. per cwt.

The year 1740 marked for Sheffield, and indeed for the world, the beginning of an epoch of great metallurgical importance. Benjamin Huntsman, a well-known clockmaker of Doncaster, found that shear steel, on account of its sometimes varying temper and of its weld-lines, often presented uneven hardness and exasperating flaws when made into clock springs. He consequently determined to make a steel even in texture and free from weld flaws. He experimented successfully, and worked out a method for the production of sound steel ingots by the fluid or crucible process, and so founded in Sheffield an industry, destined to become world-wide, which soon extended the fame of Sheffield steel throughout the civilised world.

(A composition typical of crucible cast-steel was then given. It is less pure than shear steel, but sounder, being free from weld-lines. It is said that the famous American, General Sherman, when asked to "spare the good Indians," replied that the only good Indians he had ever met were dead Indians. Be this as it may, it is certain that no steel can be good unless it is properly "killed," or, in other words, "dead melted."

Fig. 1 shows two crucible steel ingots of identical composition and weight when poured in a "lively" and in a "killed" condition. Ignoring the "pipe," or central contraction cavity, the killed steel is quite solid, whilst the unkilled metal is riddled from end to end with gas cavities or "blowholes," containing, under pressure, hydrogen, carbonic oxide, and nitrogen gases, evolved in the plastic steel during solidification, and thus rendering the ingot commercially worthless. The sound and hence apparently much smaller ingot has been "killed" by the presence of a trace (say 0·01 per cent.) of metallic aluminium. The scientific explanation of this, the most remarkable phenomenon in the whole range of steel metallurgy, may be found in text-books or in reports of metallurgical lectures, but the present lecturer must confess that he is no nearer a convincing solution of this problem than when he began his researches twenty-five years ago.

It is next necessary to correlate the chemical and micrographic analyses of the plain carbon steel upon which the world depended for its cutting implements from the time of Homer to 1870.

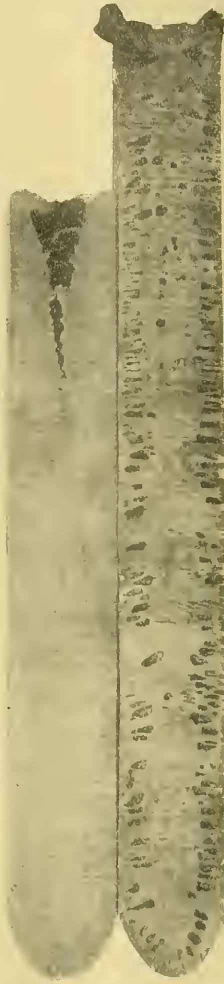

FIG. 1.

The structure of pure Swedish iron is usually contaminated with a little slag. Ignoring this, the mass consists of white allotrimorphic crystals of iron with optically black boundaries.

In a micrograph of nearly pure iron containing about 0·4 per cent. of carbon, almost half the mass consists of the dark-etching compound constituent pearlite.

The structure of nearly pure iron containing 0·89 per cent. of carbon consists entirely of pearlite, a mechanical mixture of 87 per cent. of iron with 13 per cent. of normal carbide of iron, Fe_3C. The mass abrasion hardness of normal pearlite is about 4·5—that is, between fluorspar and apatite on Moh's mineral scale.

We have next to consider the phenomena known as the hardening and tempering of steel.

Figs. 2 and 3 show very clearly the beginning, the progression and end of the hardening of steel—that is to say, the transformation (during a thermal amplitude of perhaps 3° C.) of the compound constituent pearlite ($21Fe+Fe_3C$) to the micrographically amorphous constituent hardenite, which corresponds to the empirical figures $Fe_{24}C$, in which the carbide of iron, owing to the quenching, is trapped in some molecular association with the whole of the iron. The constituent hardenite has a hardness of 7 on Mohr's mineral scale—that is to say, it is as hard as quartz, flint, or rock crystal.

It is a little difficult to realise how much the thermal capability of the mineral pearlite (with a hardness of 4·5) to transform itself into the igneous rock hardenite (with a hardness of 7) has contributed to the advance of civilisation and to the material well-being of the human race. But unfortunately it was found that hardenite was thermally very unstable, and that its cutting powers were greatly limited by the fact that the heat of friction in turning operations caused the hardenite to revert largely to relatively soft pearlite at a blue heat, say, 300° C. This property naturally limited the operations of engineers as to speed, as to traverse, and as to depth of cut, and consequently as to the cost and rate of output of all the engines and appliances necessary to our modern civilisation.

(A tempering diagram was then explained in which the black areas show the evolution of the latent heat of hardening, and consequently the transformation of the quartz-like hardenite to soft pearlite. This change at about 250° C. acquires a marked increase in velocity which reaches a maximum at about 300° C. Here the soft pearlite becomes the predominant partner, and the cutting power of the mass has practically vanished.)

About the year 1870 marked the first beginnings of an epoch in cutting-steel metallurgy, which may be called the tungsten-chrome era. Robert Forrester Mushet, at the Clyde Works, Sheffield, began to manufacture on a considerable scale his "self-hardening steel." Mushet had practically discovered that when carbon steel was alloyed with a large percentage of tungsten, it, when cooled from a yellow heat in a draught of air, was not only sufficiently hardened, but, owing to the fortifying action of the tungsten on the carbon, the hardenite was thermally considerably more stable than that of plain carbon steel.

It is probable that in Mushet's early steels the "letting-down" point

FIG. 2.—Carbon 0·89 per cent. The edge A was quartz-hard, stripping file teeth. The edge C was quite soft to the file. Etched 5/8 in. diameter disc. Magnified about 12 diameters after differential heating and rapid quenching. For high-power magnification see Fig. 3.

Transformation nearly completed. Temperature about 730° C. Transformation half completed. Temperature about 729° C. Transformation beginning. Temperature about 728° C.

FIG. 3.—Pale areas, hardenite. Laminated areas, normal pearlite. Dark borders, troostitic pearlite. [Carbon 0·89 per cent. Magnified about 450 diameters.]

of the hardenite was raised to a temperature of perhaps 400° C., thus enabling engineers to take bigger cuts and work at higher speeds. Later, about 1880, Mushet still further fortified his hardenite by the addition of relatively small percentages of chromium, and between 1880 and 1900 self- or air-hardening steels were produced by many steel manufacturers in considerable variety.

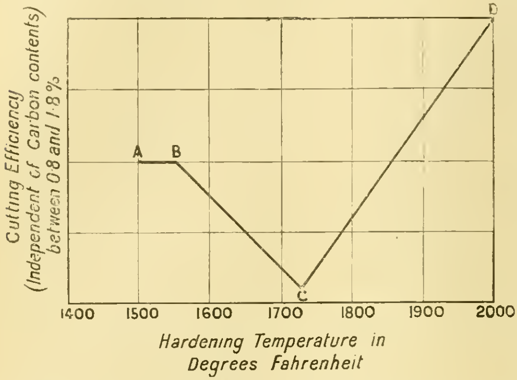

Fig. 4.—Physical diagram claimed by Messrs. Taylor and White for tungsten-chrome steels

In connection with cutting steels, a profound sensation was made throughout the steel world when, at the Paris Exhibition in 1900, the Bethlehem Steel Co. of America showed turning tools made under the alleged patent of Messrs. Taylor and White, cutting very mild steel at a speed which rendered the nose of the tool red-hot. It was obvious that in these tools the thermal stability of the hardenite had been raised to perhaps 600° C. The chemical compositions in the patent embodied nothing which had not been included in the Mushet type of steel for a period of about twenty years prior to the date of the American patent. In fact, what Taylor and White had really done was to show that this type of steel was capable of retaining its cutting edge at a much higher temperature than most engineers and metallurgists had realised. For this demonstration every credit is due to the Bethlehem Company.

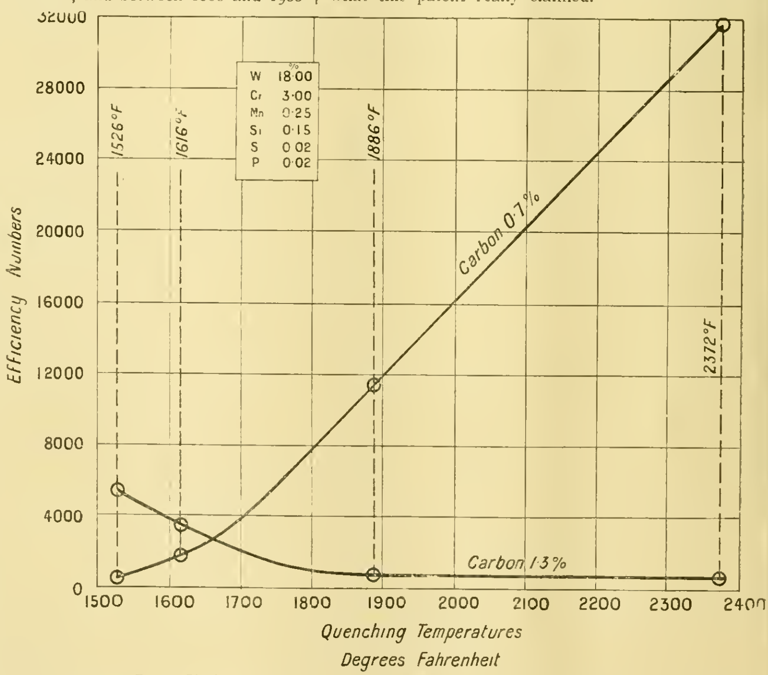

Fig. 5.—Physical curves obtained by Arnold and McWilliam for tungsten-chrome steels

Sheffield steel-makers, realising future possibilities, made from the year 1900 and onwards a series of experimental researches which eventually gave to engineers that astounding material known as high-speed steel, in which the thermal stability of the fortified hardenite was raised to about 700° C., and the striking difference in chemical composition between Mushet's and high-speed steels was shown; nevertheless, the latter are merely a progressive experimental development of the former.

The claims of the Taylor-White patent were the subject of a protracted lawsuit, the costs of which were about 50,000*l*. In the end, Mr. Justice Cross, of the United States Circuit Court, in a lengthy and luminous judgment, pronounced the Taylor-White patent to be absolutely invalid. Nevertheless, it is still claimed that the patent in suit was utilised by British manufacturers in producing modern high-speed steel. It is, therefore, only fair to consider what this patent really claimed.

Fig. 4 shows a physical curve of tungsten-chrome steels which the patentees claimed to have discovered. The coordinates are vertically the cutting efficiencies of tungsten-chrome steels with any carbon from 0·8 to 1·8 per cent. (the amount being a matter of indifference), and horizontally the hardening temperatures in degrees Fahrenheit. The short horizontal line "A–B" between 1500° and 1550° F. was alleged to be the range in which, prior to the patent, all tungsten-chrome air-hardening steel had been hardened. The falling line "B–C" between 1550° and 1725° F. was stated to be the breaking-down range discovered by the patentees, along which the cutting power of the steel steadily deteriorated. Then along the rising line "C–D," from 1725° to 2000° F (the maximum temperature specified in the patent), the quality of the steel improved as the temperature of hardening rose, until in the higher part of this range the turning tools had an efficiency never before achieved in the art, and in effect (to use the words of Coleridge's "Ancient Mariner") the patentees claimed:—

> We were the first that ever burst
> Into that silent sea.

My late colleague, Dr. A. McWilliam, and I were commissioned to investigate at Sheffield University the accuracy or otherwise of the curve specified in the patent. The results are embodied in Fig. 5. The coordinates are, horizontally hardening temperatures in degrees F., and vertically cutting efficiency numbers obtained by the approximate and relative formula $e=t\times s^2$, where e is an efficiency number, t the time endurance in minutes, and s the cutting speed, *caeteris paribus*, in feet per minute. It will be seen that with a steel containing about 17 per cent. of tungsten, 3 per cent. of chromium, and 1·3 per cent. of carbon, the maximum efficiency number of about 5000 is obtained at the lowest temperature, 830° C., after which the higher the hardening temperature the less the efficiency number, which at 1300° C. or 2400° F. has fallen to 500, or only twice the efficiency of plain carbon steel. In a similar steel, containing, however, only 0·7 per cent. of carbon, the efficiency number at 830° C. is only about 500, but the efficiency steadily rises with the hardening temperature, until at 1300° C. or 2400° F. it reaches the astounding number of about 32,000. In a word, there is no breaking-down range, and so far from the percentage of carbon being immaterial the cutting efficiency is actually a function of the carbon and hardening temperatures.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The council, in accepting the resignation by Prof. J. H. Poynting of the office of dean of the faculty of science, has passed the following resolution:—"That this council deeply regret the illness which has deprived them of the greatly valued and long-continued services of their former colleague, Dr. Poynting, at their meetings, and earnestly trust that his health, now happily restored, may be preserved for many years."

Prof. Barling has resigned the chair of surgery on his election as Vice-Chancellor.

Dr. Alfred H. Carter has resigned the chair of medicine, and the following resolution has been passed by the council:—"That the council accepts with great regret the resignation of Dr. A. H. Carter of his appointment as professor of medicine in this University. It desires to thank him for his valuable services not only as teacher during the past twenty years, but also for the great assistance he rendered in promoting the union of the medical faculty of Queen's College with Mason College, a step which materially advanced medical education and the University idea in Birmingham."

CAMBRIDGE.—The following is a summary of benefactions received by the University during the year ended December 31, 1912:—

	£	s.	d.
Gonville and Caius College, towards the maintenance of the new buildings for physiology and experimental psychology	500	0	0
Dr. J. B. Hurry, St. John's College, for the endowment of a research studentship in physiology to be called the Michael Foster research studentship	1100	0	0
Anonymous, for the endowment of the Arthur Balfour professorship of genetics	20,000	0	0
Balfour Library Endowment Fund, subscribers to	2302	3	2
Col. W. Harding, for the endowment of a lectureship in zoology	1100	0	0
St. John's College, towards the equipment of the Solar Physics Laboratory on its installation at Cambridge ...	500	0	0
Anonymous, for the purpose of increasing the stipend of the director of the Fitzwilliam Museum	100	0	0
	£25,602	3	2

In addition, sums amounting to about 10,000*l.* have been presented to the University. These include 5000*l.* from Mr. Otto Beit, 1000*l.* from the Mercers' Company, 1000*l.* from Messrs. Rothschild and Son, and 200*l.* from Mr. Almeric Paget, M.P., for the new school of physiology.

The Vice-Chancellor gives notice that he has appointed Saturday, April 19, as the day for the election to the Plumian professorship of astronomy and experimental philosophy vacant by the death of Sir George Darwin. Candidates for the professorship are requested to send their names to the Vice-Chancellor on or before Friday, April 11.

The director of the Solar Physics Observatory has, with the consent of the Vice-Chancellor, appointed the following to be members of the staff of the Solar Physics Observatory:—F. J. M. Stratton, to be assistant director; C. T. R. Wilson, to be observer in meteorological physics; F. E. Baxandall, to be first senior observer; C. P. Butler, to be second senior observer; W. E. Rolston, to be first junior observer; W. Moss, to be second junior observer.

LEEDS.—Arrangements are being made for the establishment of a Yorkshire Summer School of Geography to be organised in alternate years by the Universities of Leeds and Sheffield. The course for 1913 will be held at Whitby, from August 4–25, under the auspices of the University of Leeds. The aims of the course are to provide instruction which shall equip students for attacking problems in the regional geography of any area, and to discuss and elucidate problems connected with the teaching of geography. The work of the school will include field work, laboratory work, and lectures on geological, meteorological, economic, and historical aspects of the geography of Yorkshire. The agricultural, mining, textile, and metallurgical industries will be dealt with, as well as questions connected with language and place-names. Further information will be available in June, on application to the secretary, Summer School of Geography, the University, Leeds.

In September next Prof. H. R. Procter will retire from the chair of applied chemistry (chemistry of leather manufacture) which he has held for the past twenty-two years. Prof. Procter is prepared and desirous to continue in an honorary capacity the researches into the chemistry of the tanning process and the behaviour of colloids, on which he has been engaged. To commemorate the great services he has rendered to leather industries it is therefore proposed to erect and equip an International Research Laboratory, of which he will be honorary director so long as he desires to continue his investigations. The laboratory will be open, without charge, to competent students from every part of the world. The council of the University has provided a site, and an influential committee, representing the scientific and commercial sides of the leather industry, has been formed to appeal for subscriptions. The sum desired is 4000*l.* for the establishment of the laboratory, and 300*l.* a year for current expenses and assistance. The honorary treasurer of the committee is Mr. W. J. Rivington, *The Leather Trades Review*, 24 Mark Lane, London, E.C.

The University is to receive a grant of 1000*l.* a year through the Board of Agriculture from the Development Fund for investigations into the subject of animal nutrition. The work is to be carried out in consultation with the existing Research Institution at Cambridge, so that there shall be no unnecessary overlapping between the two schemes.

Science announces that gifts amounting to more than 100,000*l.* to Washington and Lee University, Lexington, Va., are provided for in the will of Mr. R. P. Doremus, who died on February 1.

THE council of the University of Bristol has been informed that the late Mr. Augustus Nash has bequeathed the residue of his estate in trust to pay a near relative the income during life, and afterwards to pay the capital sum to the University in the hope that it may be used to advance natural sciences, particularly chemistry. The sum will be about 18,000*l.*

IT will be remembered that, in 1909, the Goldsmiths Company gave 50,000*l.* towards the extension of the engineering department in the Central Technical College. The company has now offered to pay the entire cost of the new building, which means an added gift of 37,000*l.* The Goldsmiths' Company has attached the condition that the portion of the capital belonging to the Imperial College of Science and Technology which will be thus set free shall be added to the endowment fund, the income being used for higher educational and research work.

A MEMORIAL signed by a large number of educationists and others has been presented to the Prime Minister urging the need for an immediate reform of our national education. The petition states that the memorialists "are of opinion that this country has been slow, as compared with some other nations, in recognising how greatly education increases national strength when it permeates every class of the community and makes for the unity of the nation. They, therefore, urge that adequate provision for education in all grades, from the primary school to the university, be made in every defined area of the population; that the artificial barriers between grade and grade should be, so far as possible, broken down, and facilities given to every child, whatever his birth or creed, to proceed unhindered to his appropriate development and towards a national ideal of intellectual, spiritual, and vocational efficiency." The petition urges the Government to undertake forthwith "a comprehensive reform of the national education, making for the good of the nation as a whole.

THE Admiralty has issued a circular detailing the steps it is proposed to take to supplement the supply of officers for the Navy. The new requirements of the Air and Submarine Services, the establishment of the Dominion Navies, and other causes all make an increased number of naval officers necessary. This greatly augmented demand will be met in part by promotions from the lower deck, by absorption of officers from the R.N.R., and in other ways, but to provide officers available for service in 1920 a new policy is to be adopted in addition to existing plans. The special entry is proposed of a limited number of cadets of about the age of eighteen, who have completed their general education. A number of such cadets not exceeding thirty annually will be admitted by competitive examination of selected candidates. They will be sent to a naval establishment for a course of professional training before being distributed as midshipmen in the fleet. The same subsequent career will be open to them as to officers who have entered through Osborne. They will be free to volunteer for service in any one of the special branches. The entrance examination will be such as to attract candidates who have received at school a good grounding in mathematics, mechanics, and physics. The subjects of examination will be nearly identical with those prescribed for entry to Woolwich, but some weight will be assigned to an elementary knowledge of engineering science in addition to the usual Woolwich subjects. The course of training which these cadets will undergo after admission will consist largely of instruction of a practical kind in naval engineering and in the service applications of electricity. The first special entry under these conditions will take place by competitive examination in June next. An Admiralty Committee will interview each candidate and examine credentials furnished by the headmaster of the school he is attending or last attended. On the report of this committee it will be determined whether the candidate shall be admitted to compete.

DURING the International Kinematograph Exhibition, to be held at Olympia on March 22–29, there will be an educational conference, at which the use and value of the kinematograph as an aid to instruction will be discussed. It would, of course, be absurd to suggest that direct observation, or mental work requiring the individual activity of the pupil, can be replaced as educational factors by the more or less passive contemplation of moving pictures; nevertheless, there are many subjects, which can be illustrated more effectively by the kinematograph than by any other means. Moving pictures representing the peoples, industries, and characteristics of many lands give more accurate impressions than many pages of a geographical reading book; the dry bones of history may be made to live in the minds of pupils by means of some of the historical films available; animals may be seen in their natural haunts; the stages of development of an animal or plant can be followed in quick and orderly sequence; the nature of disease and the value of preventive medicine can be illustrated; and many other points not easily explained can be presented in the most striking manner. At the forthcoming conference the application of the kinematograph to instruction in various branches of the curriculum, and to education generally, will be discussed. Among the speakers will be Dr. Lyttelton (headmaster of Eton), Mr. Stephen Paget, Miss Von Wyss (president of the Nature Study Union), Dr. Walmsley, Mr. F. W. Sanderson (headmaster of Oundle School), Mr. A. P. Graves (late H.M. Chief Inspector of Schools). Messrs. Pathé Freres will show many of their educational films during the conference in illustration of the various subjects brought forward. The kinematograph may be made such an effective educational instrument that encouragement should be given to all who are endeavouring to discover its best uses and to produce pictures above the penny-dreadful type which is now too common.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 6.—Sir Alfred Kempe, vice-president and treasurer, in the chair.—Prof. J. C. **Bose**: An automatic method for the investigation of the velocity of transmission of excitation in Mimosa. The research was undertaken to decide the question whether in *Mimosa pudica* stimulus gives rise to a mere passage of hydro-mechanical disturbance or a transmission of true excitation. The results obtained warrant the conclusion that there is transmission of true excitation.—W. K. **Spencer**: The Evolution of the Cretaceous Asteroidea. An endeavour is made to trace the evolution of the starfish through the whole of the Cretaceous deposits. At the first sight the material appeared to be unpromising, for complete or even fragmentary specimens are rare. It has been found possible, however, to use the isolated marginal plates which are found fairly commonly on weathered chalk surfaces. It is shown that these marginal plates have a shape and ornament characteristic of each distinct species. The species may be arranged in lineages, and the examination of large collections made by English and Continental workers make it feasible to trace the life-history of most of the lineages. —Dr. E. A. Newell **Arber**: A preliminary note on the fossil plants of the Mount Potts Beds, New Zealand, collected by Mr. D. G. Lillie, biologist to Capt. Scott's Antarctic Expedition in the *Terra Nova*, in 1911. The communication briefly discusses the first results, which have reached this country, of the late Capt. Scott's second Antarctic Expedition. In the winter months of the last two years the *Terra Nova* has been at work in New Zealand waters. During these periods Mr. D. G. Lillie, one of the biologists of the expedition who has been attached throughout to the *Terra Nova*, has been endeavouring to clear up on the evidence of the fossil floras some of the many points which remain unsolved with regard to the stratigraphical geology of New Zealand. In particular, he has made large collections from the Mount Potts Beds, in Ashburton County, Canterbury. Whether these beds contain Glossopteris, as asserted by Hector and others, has long been a matter of dispute, for the whole question whether New Zealand formed part of the great southern Permo-Carboniferous continent of "Gondwanaland" depends entirely on the character and age of the flora of these beds. As it proves, the flora of these beds is thoroughly Mesozoic. The flora as a whole consists chiefly of Rhætic plants, though a few Jurassic types also occur, and thus the age of the beds is either Rhætic or Lower Jurassic. The Mount Potts beds are admittedly the oldest plant-bearing series, in a geological sense, as yet discovered in New Zealand. No Palæozoic plants are known from these islands, and there is thus no evidence that they formed part of "Gondwanaland" in Permo-Carboniferous times.—Sir D. **Bruce**, Majors D. **Harvey** and A. E. **Hamerton**, Dr. J. B. **Davey**, and Lady **Bruce**: (1) Trypanosomes found in the blood of wild animals living in the sleeping sickness area, Nyasaland. (2) Trypanosome diseases of domestic animals in Nyasaland. II., *Trypanosoma Caprae* (Kleine). (3) Morphology of various strains of the trypanosome causing disease in man in Nyasaland. I., The human strain.

Linnean Society, February 20.—Prof. E. B. Poulton, F.R.S. president, in the chair.—Roland H. **Deakin**: Anatomy of the larva of *Phryganea stricta*.—W. Botting **Hemsley**: The genera Radamæa, Benth., and Nesogenes, A. DC. *Radamaea montana* is a shrub from Madagascar, and some imperfect specimens of a similar plant were referred to his *R. prostrata*. On comparing these specimens with some collected on the *Sealark* expedition by Prof. J. Stanley Gardiner and Mr. J. C. F. Fryer, the author found it had to be transferred to its proper genus, Nesogenes. Four species of the latter genus are now known, including a new one from Aldabra, named *N. Dupontii*, Hemsl., after the discoverer.—Prof. R. J. Harvey **Gibson** and Margaret **Knight**: Marine Algæ collected by Mr. Cyril Crossland in the Red Sea. Part ii. was mainly a list of species, forty-six in number, thirty-five of which are additions to the former list. The authors have observed sexual and asexual organs, not merely on the same plant, but on the same branch, in several species, and consider the phenomenon to be by no means exceptional.

BOOKS RECEIVED.

Problems of Life and Reproduction. By Prof. M. Hartog. Pp. xx+362. (London: J. Murray.) 7*s*. 6*d*. net.

Geschichte der deutschen Naturphilosophie. By Dr. C. Siegel. Pp. xv+390. (Leipzig: Akademische Verlagsgesellschaft m.b.H.) 10 marks.

A Foundation Course in Chemistry for Students of Agriculture and Technology. By J. W. Dodgson and J. A. Murray. Pp. x+244. (London: Longmans and Co.) 3*s*. 6*d*. net.

An Introduction to Metaphysics. By Prof. H. Bergson. Authorised translation by T. E. Hulme. Pp. vi+79. (London: Macmillan and Co., Ltd.) 2*s*. net.

The Development of Mathematics in China and Japan. By Y. Mikami. Pp. x+347. (Leipzig: B. G. Teubner; London: Williams and Norgate.) 18 marks.

The Elements of Heating and Ventilation. By Prof. A. M. Greene, jun. Pp. vi+324. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

Vertebrate Embryology. By Dr. J. W. Jenkinson. Pp. 267. (Oxford: Clarendon Press.) 12*s*. 6*d*. net.

Development and Purpose: an Essay towards a Philosophy of Evolution. By Prof. L. T. Hobhouse. Pp. xxix+383. (London: Macmillan and Co., Ltd.) 10*s*. net.

Aristarchus of Samos. The Ancient Copernicus. A History of Greek Astronomy to Aristarchus, together with Aristarchus's Treatise on the Sizes and Distances of the Sun and Moon. A New Greek Text, with Translation and Notes. By Sir T. Heath. Pp. viii+425. (Oxford: Clarendon Press.) 18*s*. net.

Materialien für eine wissenschaftliche Biographie von Gauss. By F. Klien and M. Brendel. Heft 2/3. Pp. 143. (Leipzig: B. G. Teubner.) 4.40 marks.

Report of the Thirteenth Meeting of the Australasian Association for the Advancement of Science, held at Sydney, 1911. Pp xciii+766+48 plates. (Sydney.)

Chloride of Lime in Sanitation. By A. H. Hooker. Pp. v+231. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.)

The Trades School in the Transvaal. By W. J. Horne. Pp. viii+96. (Johannesburg: Argus Printing and Publishing Co., Ltd.)

Union of South Africa. Department of Agriculture. Report with Appendices for the period May

31, 1910, to December 31, 1911. Pp. iv+663+plates. (Cape Town: *Cape Times*, Ltd.)

L.M.B.C. Memoirs of Typical British Marine Plants and Animals. xxi., Eupaguans. By Dr. G. Jackson. Pp. viii+79+vi plates. (London: Williams and Norgate.) 2*s*. 6*d*.

Philips's Panama Canal Route Globe. (London: G. Philip and Son, Ltd.) 2*s*. 6*d*. net.

The Economics of Everyday Life: a First Book of Economic Study. Part i. By T. H. Penson. Pp. xiv+174. (Cambridge University Press.) 3*s*. net.

The Manufacture of Sulphuric Acid and Alkali with the Collateral Branches. By Prof. G. Lunge. Fourth edition. Vol. i., part i. Pp. xxiv+582. Part ii. Pp. xii+583–1078. Part iii. Pp. xii+1079–1617. (London: Gurney and Jackson.) 3*l*. 3*s*. net.

Verhandlungen des Naturhistorischen Vereins der preussischen Rheinlande und Westfalens. Neunundsechzigster Jahrgang, 1912. Erste Hälfte. Pp. lv+223+plates. (Bonn: F. Cohen.)

Technical School Organisation and Teaching. By C. Hamilton. Pp. xii+178. (London: G. Routledge and Sons, Ltd.) 2*s*. 6*d*. net.

Anleitung zur Kultur der Mikroorganismen. By Dr. E. Küster. Zweite Auflage. Pp. v+218. (Leipzig and Berlin: B. G. Teubner.) 8 marks.

The Organometallic Compounds of Zinc and Magnesium. By Dr. H. Wren. Pp. viii+100. (Chemical Monographs.) (London: Gurney and Jackson.) 1*s*. 6*d*. net.

La Télégraphie et la Téléphonie Simultanées et la Téléphonie Multiple. By K. Berger. Pp. 134. (Paris: Gauthier-Villars.) 4.50 francs.

Les Appareils D'Intégration. By H. de Morin. Pp. 208. (Paris: Gauthier-Villars.) 5 francs.

Aus Natur und Geisteswelt. Band 393, Die Dampfmaschine. By Prof. R. Vater. Dritte Auflage. Pp. vi+104. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

First-Year Course in General Science. By E. A. Gardiner. Pp. vi+113. (London: W. Heinemann.) 2*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 13.

ROYAL SOCIETY, at 4.30.—A Simple Method of Finding the Approximate Period of Stable Systems: A. Mallock.—The Motion of Electrons in Gases: Prof. J. S. Townsend and H. T. Tizard.—The Self Inductance of Circular Coils of Rectangular Section: Prof. T. R. Lyle.—Ammonium Ferrous Sulphate and its Alkali-Metal Isomorphs: Dr. A. E. H. Tutton.—The Recombination of the Ions produced by Röntgen Rays in Gases and Vapours: H. Thirkill.—Optical Investigation of Solidified Gases. III. The Crystal-properties of Chlorine and Bromide: Dr. W. Wahl.

ROYAL INSTITUTION, at 3.—Surface Energy: W. B. Hardy.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Power Supply on the Rand: A. E. Hadley.

CONCRETE INSTITUTE, at 7.30.—The Strength of Cement: H. C. Johnson.

INSTITUTION OF MINING AND METALLURGY, at 8.—Annual General Meeting.

MATHEMATICAL SOCIETY, at 8.—Some Cases of Tidal Motion of Rotating Sheets of Water: J. Proudman.—Indeterminate Equations of the Third and Fourth Degree: L. J. Mordell.

SOCIETY OF DYERS AND COLOURISTS, at 8.—Stripping Agents for Garment Dyers: F. G. Newbury.—A Few Notes on Fur Dyeing: M. C. Lamb.

FRIDAY, MARCH 14.

ROYAL INSTITUTION, at 9.—Great Advance in Crystallography: Dr. A. E. H. Tutton.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Some Effects of Superheating and Feed-water Heating on Locomotive Working: F. H. Trevithick and P. J. Cowan.

PHYSICAL SOCIETY (University College, Gower Street), at 5.—Demonstration of Spark Photographs: W. B. Haines.—(1) Some Oscillograms of Condenser Discharges and a Simple Theory of Coupled Circuits; (2) Exhibition of Braun Kathode-Ray Tubes and an Electrostatic Machine for Working them, used as a High-frequency Oscillograph: Prof. J. A. Fleming.—The Stretching and Breaking of Sodium and Potassium: B. B. Baker.—The Latent Heat of Evaporation of Aqueous Salt Solutions: R. G. Lunnor.—Some Flame Spectra: Dr. E. N. da C. Andrade.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Sounds Alleged to Accompany Flights of Meteors: A. King.—Note on the Possibility of Refraction by the Sun's Atmosphere. Papers of the I.U.S.R. No. VIII.: R. S. Capon.—Observations of Gale's Comet: Sydney Observatory.—A Family of Oscillating Orbits of Short Period; H. R. Willard.—Note on the Nebula HI Cassiopeiæ: Mrs. Isaac Roberts.—Notes on Fireballs and Shooting Stars: W. F. Denning.—The Variable Star R Cygni: E. E. Barnard.—A Formula for Correcting Statistics for the Effects of a Known Probable Error of Observation: A. S. Eddington.—*Probable Papers*: Observations made with the Durham Almucantar during 1912: E. H. Hills and F. C. H. Carpenter.—Enhanced Lines in the Early Spectrum of Nova Geminorum No. 2: H. F. Newall and F. J. M. Stratton.—The Distribution in Space of the Stars of Carrington's Circumpolar Catalogue: F. W. Dyson.—The Distribution in Space of the Bright Stars: A. S. Eddington.—Report on the Expedition to Passa Quatro, Brazil, to observe the Total Solar Eclipse of 1912 (October 10): A. S. Eddington and C. Davidson.

SATURDAY, MARCH 15.

ROYAL INSTITUTION, at 3.—The Properties and Constitution of the Atom: Sir J. J. Thomson, O.M.

MONDAY, MARCH 17.

VICTORIA INSTITUTE, at 4.30.—The Bearing of Archæological and Historical Research on the New Testament: Rev. Parke P. Flournoy.

TUESDAY, MARCH 18.

ROYAL STATISTICAL SOCIETY, at 5.—Some Statistical Problems suggested by the Sickness and Mortality Data of Certain of the Large Friendly Societies: Dr. E. C. Snow.

ZOOLOGICAL SOCIETY, at 8.30.—Remarks on the Relationship of the Big Game of Africa to the Spreading of Sleeping Sickness: Dr. W. Yorke.—Variations in the Skeleton of the Pectoral Fins of Polypterus: Edith E. Bamford.—A Descriptive Study of an Oligochæte Worm of the Family Enchytræidæ: H. H. Stirrup.—(1) A Collection of Fishes made by Prof. Francisco Fuentes at Easter Island; (2) A Revision of the Fishes of the Genus Kuhlia: C. Tate Regan.—The Polyzoa of Waterworks: Dr. S. F. Harmer.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: Notes on City Passenger-Transportation in the United States: G. D. Snyder.

WEDNESDAY, MARCH 19.

ENTOMOLOGICAL SOCIETY, at 8.—The Classification of the British Crabronidæ (Hymenoptera): Dr. R. C. L. Perkins.

GEOLOGICAL SOCIETY, at 8.—The Geology of Northern Peru: Tertiary and Quaternary Birds: Beeby Thompson.—The Internal Cranial Elements and Foramina of *Dapedius Granulatus*: G. Allan Frost.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—Wordsworth.

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ROYAL INSTITUTION OF GREAT BRITAIN.

ALBEMARLE STREET, PICCADILLY, W.

LECTURE ARRANGEMENTS AFTER EASTER, 1913.

AT THREE O'CLOCK AFTERNOON.

ARTHUR SMITH WOODWARD, Esq., LL.D., F.R.S.—Two Lectures on "RECENT DISCOVERIES OF EARLY MAN." On Tuesdays, April 1, 8.

Professor WILLIAM BATESON, D.Sc., F.R.S.—Two Lectures on "THE HEREDITY OF SEX AND SOME COGNATE PROBLEMS." On Tuesdays, April 15, 22.

Professor W. STIRLING, M.D., LL.D., D.Sc. Three Lectures on "RECENT PHYSIOLOGICAL INQUIRIES." On Tuesdays, April 29, May 6, 13.

Professor T. B. WOOD, M.A. Three Lectures on "RECENT ADVANCES IN THE PRODUCTION AND UTILIZATION OF WHEAT IN ENGLAND." On Tuesdays, May 20, 27, June 3.

E. FRANKLAND ARMSTRONG, Esq., D.Sc. Two Lectures on (1) "THE BRIDGE INTO LIFE"; (2) "COLOUR IN FLOWERS." On Thursdays, April 3, 10.

Professor JOHN GARSTANG, B.Litt., F.S.A. Three Lectures on "THE PROGRESS OF HITTITE STUDIES." On Thursdays, April 17, 24, May 1.

EDWARD ARMSTRONG, Esq., F.B.A. Two Lectures on "FLORENTINE TRAGEDIES." On Thursdays, May 8, 15.

Professor W. J. POPE, LL.D., F.R.S. Three Lectures on "RECENT CHEMICAL ADVANCES." On Thursdays, May 22, 29, June 5.

ARTHUR M. HIND, Esq. Two Lectures on (1) "VAN DYCK AND THE GREAT ETCHERS AND ENGRAVERS OF PORTRAIT"; (2) "REMBRANDT'S ETCHINGS." On Saturdays, April 5, 12.

Professor SIR WALTER RALEIGH. Three Lectures on (1) "BOCCACCIO"; (2) "MEDIEVAL FRENCH NOVELISTS"; (3) "CHAUCER." On Saturdays, April 19, 26, May 3.

H. A. HUMPHREY, Esq., M.Inst.C.E., F.R.G.S. Two Lectures on "HUMPHREY INTERNAL COMBUSTION PUMPS." On Saturdays, May 10, 17.

Professor E. RUTHERFORD, D.Sc., LL.D., F.R.S. Three Lectures on "RADIOACTIVITY." (The Tyndall Lectures.) On Saturdays, May 24, 31, June 7.

Subscription (to Non-Members) to all Courses of Lectures (extending from Christmas to Midsummer), Two Guineas. Subscription to a Single Course of Lectures, One Guinea, or Half-a-Guinea, according to the length of the Course. Tickets issued daily at the Institution, or sent by post on receipt of Cheque or Post-Office Order.

Members may purchase not less than Three Single Lecture Tickets, available for any Afternoon Lecture, for Half-a-Guinea.

The FRIDAY EVENING MEETINGS will be resumed on April 4, at 9 p.m., when Dr. JAMES J. DOBBIE will give a Discourse on "THE SPECTROSCOPE IN ORGANIC CHEMISTRY." Succeeding Discourses will probably be given by Mr. CHARLES J. P. CAVE, Dr. T. MARTIN LOWRY, Professor JOHN GARSTANG, Mr. H. G. PLIMMER, Captain C. G. RAWLING, Professor SILVANUS P. THOMPSON, Dr. FRANCIS WARD, and other gentlemen. To these Meetings Members and their Friends only are admitted.

Members are entitled to attend all Lectures delivered in the Institution, the Libraries, and the Friday Evening Meetings, and their Families are admitted to the Lectures at a reduced charge. Payment: First Year, Ten Guineas; afterwards, Five Guineas a Year; or a composition of Sixty Guineas.

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The Protozoa and the other more important groups of the Protista	Mr. CLIFFORD DOBELL, M.A.

Lectures Free. Fee for practical work for each Course, £2.

For further information and for admission to the above Courses, apply to the Secretary of the College.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY,

SOUTH KENSINGTON.

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Subject.	*Conducted by*
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Fibres and Fibre-Yielding Plants	Professor GROOM, M.A., D.Sc., F.L.S.

For further particulars, application should be made to the SECRETARY.

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Rector—The Right Hon. the EARL OF MINTO, P.C., G.C.M.G., LL.D.

Principal and Vice-Chancellor—Sir WILLIAM TURNER, K.C.B., D.C.L., LL.D., D.Sc., M.B., &c.

Secretary of Senatus—Professor Sir LUDOVIC J. GRANT, Bart., B.A., LL.D.

The SUMMER SESSION, except in Law, extends from about the middle of April to the end of June; the WINTER SESSION begins about the beginning of October and closes about the middle of March.

The University embraces SIX FACULTIES, viz. ARTS, SCIENCE, DIVINITY, LAW, MEDICINE AND SURGERY, and MUSIC, in all of which full instruction is given and Degrees are conferred. There are many different avenues to the ARTS DEGREES, the graduation subjects embracing English, History, Modern Languages, Science, &c., besides Ancient Languages, Philosophy, Mathematics, &c. The wide scope of the Arts Curriculum permits of the combination of Arts, Science, Medical or Special Studies; and it has been shown by successes of Edinburgh students in the Civil Service Examinations that it is possible to combine study for Degrees in Arts, Science, or Law with preparation for this and other Special Examinations. In addition to the Ordinary and Honours Degrees in Arts, the Higher Degrees of D.Litt., D.Phil., and D.Sc. are conferred. Education in Military subjects is given in connection with the Scheme of allotment of Army Commissions to Graduates of the University. Degrees in SCIENCE (B.Sc. and D.Sc.) may be taken in PURE SCIENCE, ENGINEERING, and in PUBLIC HEALTH, and the Degree of B.Sc. in AGRICULTURE and FORESTRY and in VETERINARY SCIENCE. There are fully equipped Science Laboratories, and other necessary appliances, in all these Departments. The curriculum in DIVINITY affords a thorough training in Theological subjects, and in Hebrew, Arabic, and Syriac. The Degree of Bachelor of Divinity (B.D.) is conferred. The LAW Faculty, besides furnishing the professional equipment necessary for those intending to practise in Scotland, contains Chairs in Jurisprudence and Public International Law, Constitutional Law and Constitutional History, Roman Law, and Political Economy, as also Lectureships in other important branches of the Law, and is thus adapted for students preparing for the Civil Service Examinations, and for legal, political, and administrative appointments generally. The Degrees of Bachelor of Laws (LL.B.) and Bachelor of Law (B.L.) are conferred. The Faculty of MEDICINE has a full curriculum in Medicine and Surgery, and is equipped with very extensive Laboratories and all other necessary appliances for Practical Teaching. Ample facilities are afforded for Clinical Instruction at the Royal Infirmary, Maternity Hospital, Royal Hospital for Sick Children, Hospital for Infectious Diseases, and Royal Asylum for the Insane. Four Degrees in Medicine and Surgery are conferred by the University, viz.: Bachelor of Medicine (M.B.), Bachelor of Surgery (Ch.B.), Doctor of Medicine (M.D.), and Master of Surgery (Ch.M.), and these Degrees qualify for practice throughout His Majesty's dominions, and for admission to the Naval, Military and other Public Medical Services in the United Kingdom. A DIPLOMA IN TROPICAL MEDICINE AND HYGIENE (D.T.M. & H.) is conferred on Graduates in Medicine of the University, and a DIPLOMA IN PSYCHIATRY (Dipl. Psych.). A University CERTIFICATE IN TROPICAL DISEASES is also conferred on qualified Medical Practitioners who have attended Courses in the University on Practical Bacteriology and Tropical Diseases. In MUSIC also there is a full course of study for graduation, and the Degrees of Mus.B. and Mus.D. are conferred.

The University Staff consists of 41 Professors, 66 Lecturers, and over 50 Assistants and Demonstrators. The annual amount available for Fellowships, Scholarships, Bursaries, Prizes, &c., is about £18,700. Facilities are afforded for research in scientific and other subjects.

Women may attend the classes in Arts, Science, Divinity, Law, and Music; and they are admitted to graduation in Arts, Science, Law, Medicine, and Music, the training for Degrees in Medicine being afforded by well-equipped Extra-academical Schools.

Information regarding Matriculation, the Curricula of Study for Degrees, &c., the Examinations for Fellowships, Scholarships, &c., may be obtained from the DEANS OF THE FACULTIES, or from the CLERK OF SENATUS; and full details are given in the University Calendar, published by JAMES THIN, 55 South Bridge, Edinburgh—price 3*s.* 6*d.* by post.

The Preliminary and Degree Examination Papers in each of the Faculties are also published by Mr. JAMES THIN, viz.—Arts and Science Preliminary Papers and Bursary Papers, 1*s.*; Medical Preliminary Papers, 6*d.*; Degree Papers—Arts, 1*s.*; Science, 9*d.*; Divinity, Law, Medicine, and Music, 6*d.* each.

By Order of the Senatus,

January, 1913. L. J. GRANT, Secretary of Senatus.

UNIVERSITY OF MANCHESTER.

FACULTY OF MEDICINE.

(INCLUDING THE DENTAL, PHARMACEUTICAL AND PUBLIC HEALTH DEPARTMENTS.)

The SUMMER SESSION will commence on Tuesday, April 15, when the registration of Students will begin at 9.30 a.m. Lectures and Practical Work will begin on Wednesday, the 16th. The Courses of Instruction which are open to Men and Women Students, also meet the requirements of other Universities and Examining Bodies.

CLINICAL INSTRUCTION.—In association with the University there are Hospitals containing over 1000 beds. The Royal Infirmary, which is in close vicinity to the University, contains 492 beds, and offers unrivalled opportunities for Clinical Study. The Dental Hospital is also adjacent to the University, and provides every modern requirement for the teaching of Dentistry.

There are Halls of Residence both for Men and Women Students.

Prospectuses, giving full information as to Courses of Study, Examinations, &c., will be forwarded on application to the REGISTRAR.

THURSDAY, MARCH 20, 1913.

COLOUR VISION.

Researches in Colour Vision and the Trichromatic Theory. By Sir William de W. Abney, K.C.B., F.R.S. Pp. xi+418+5 plates. (London: Longmans, Green and Co., 1913.) Price 21*s.* net.

THERE is certainly no living authority on "colour-vision" more competent to throw light on that intricate and perplexing subject than the author of this work. Sir William Abney has attacked the various problems which present themselves by his own methods and with the utmost completeness of detail. In almost every conceivable way he has tried to correlate the more precise physical facts, elicited by carefully and ingeniously modified experiments, with the vaguer physiological conceptions arrived at from a study of normal and abnormal sensations of colour. The present work embodies and collects into a consecutive whole a record of the author's previously published researches. The book is consequently one which will be regarded as a standard work. It gives the most complete and clear exposition of the trichromatic theory of Young-Helmholtz. It will, we venture to think, be more readily understood than Helmholtz's own latest treatment of the subject as given in the last edition of his "Physiological Optics."

So far as Sir William Abney's researches go, it must be admitted that they afford strong evidence of the fitness of the trichromatic theory to explain how normal colour sensations may be evoked by the known physical causes. The difficulty comes in attempting to explain congenital and acquired defects in colour sensation in accordance with that theory. To do so by inferring that there is then a complete absence of stimulability, or a weakening in the stimulability, of one of the three end-organs supposed to correspond to a so-called "fundamental sensation," leads to hypothetical conclusions as to the way in which colours are perceived by the colour-blind. The many interesting experiments adduced by the author in support of the idea of altered stimulability of the end-organs in the colour-blind can scarcely be said to be convincing. It may indeed be asked: Why should abnormal colour "sensation" depend at all upon abnormal "stimulability"? There are different stages in the production of colour sensations in response to objective stimuli. These are: the effect of the physical cause on the percipient elements of the retina, the conduction by the optic nerve, and, lastly, the response in the brain-cells. Might not an abnormality in the last stage, the final "response," be consistent with colour confusion complete and incomplete, altogether independent of any abnormality in the colour end-organs of the retina? In cases of acquired colour-blindness there is, in fact, good reason to refer the defect both to altered conductivity in the optic nerve-fibres and to changes in the central cells.

From the way in which colours are matched by the "colour-blind" it is difficult, apart from theory, to believe that the colour-blind spectrum is such as would appear to the normal eye anything remotely comparable to that represented for a "red-blind" and a "green-blind" individual respectively in plate i. Even admitting that there is an appreciable difference between the two classes of cases, which are thus classified in accordance with theory, it is almost inconceivable that the spectrum can appear so different in the two cases.

Some colour-blind people, it is true, are unconscious or only vaguely suspicious of their condition. But there are others who are well aware of it. Some are even keenly interested in analysing their colour-impressions and in comparing them with those of normal individuals. The writer of this notice has met with several who have done so. Without exception and without regard as to whether they might be classified as "red colour-blind" or as "green colour-blind," they have arrived at the conclusion that their yellow and blue sensations are not materially different from the normal. Their absolutely dichromatic spectrum consists of a "warm" and a "cold" colour sensation, which, when saturated, as compared with other colours to them, are often described as "vivid" and "pleasurable."

In a letter received in 1879 from Dr. William Pole, who was "colour-blind" and well known for his own contributions to this subject, he states:—"I am more than ever convinced of the enormous difficulty normal-eyed persons find in understanding what we, the colour-blind, really see." Again, in 1890, referring to Clerk Maxwell, he says:—"He examined me carefully with spectral apparatus, but he spoilt all his results by insisting that my warm colour must be the Young-Helmholtz fundamental 'green,' and as I obstinately refused to adhere to what seemed to me a preposterous contradiction of all my experience, he never published his trials. . . . Now the general opinion seems to agree with my own impression that it is yellow, *i.e.* no Young-Helmholtz fundamental at all."

Again there is surely no proof that the colour-blind see white otherwise than the normal-eyed. No difference in a white object can be seen as it is passed from the periphery of the field of vision to the centre. Yet there is a colour-blindness of the normal peripheral field which is analogous to, though possibly not identical with, congenital colour-blindness. One of the assumptions, however, which is made, in the endeavour to make the theory suit the case of colour-blindness, is that the colour-blind "white" is altogether different from the normal-eyed "white." According to Sir William Abney, the "white" of the "red-blind" is a sea-green, and that of the "green-blind" a brilliant purple. But it would appear from the nature of the actual experiments on which this assumption is based (pp. 273, 274) that there is here only a confusion between the sensations to which these colours give rise in normal eyes and the *neutral* sensations which they evoke in the colour-blind.

In every case of complete colour-blindness (which causes colour-confusion only and is distinguished, therefore, from total loss of any colour perception) there are two hues which, though most definite and vivid to the normal-eyed, appear altogether uncoloured or neutral. Only one of these neutrals is to be found in the spectrum, though both can be produced by combinations of spectral colours. This is obviously something different from a demonstration of the manner in which what to the normal eye is white is seen by the colour-blind. But it may be asked: Is there any reason for entirely giving up the trichromatic theory because it does not meet with general acceptance when "doctored" to suit the case of colour-blindness? A study of Sir William Abney's work must convince one how strongly it is supported by physical facts.

A quotation from the preface may fittingly conclude a necessarily too short notice of this valuable and comprehensive work. The author there makes the following suggestive remark:—

"A theory, to be one of perfection, must offer the truth, the whole truth, and nothing but the truth. The trichromatic theory offers the truth; but the physiologists must add their quota to make it the whole truth. There may be difficulties in welding together the physical and physiological aspects of colour vision to make a perfect theory, but it will be effected."

A MEDIEVAL PHYSICIAN.

John of Gaddesden and the Rosa Medicinae. By H. P. Cholmeley. Pp. 184. (Oxford: Clarendon Press, 1912.) Price 8*s*. 6*d*. net.

OLD books, at any rate old medical books, may, as regards their contents, be divided into three classes: those intrinsically valuable as sources of more or less original knowledge—of such are the Hippocratic writings, Galen, Alexander of Tralles, some of the Salernitan treatises, the greater medieval Italian and French surgeons, Sydenham, Morgagni—names taken at hazard; secondly, those which, although not original sources, yet enshrine more or less admirably the works of great men or of schools which had otherwise perished—of such are Celsus, our chief resource for the doctrines of Alexandrian medicine, or Cælius Aurelianus, which preserves for us some of the writings of Soranus, or Aretæus, or Oribasius—names again chosen at random, or smaller books which also, as rafts or broken pieces of the ship, may salve lesser fragments of ancient lore—books such as Aetius or Paul of Ægina; and, thirdly, old books which have no other value than the bibliophile may, in the fashion of the time, choose to confer upon them as antiques. These books, for their quaintness, may arouse some interest, and of such is the book before us.

John of Gaddesden's book may in its time have served as a handy "Practica" for his contemporaries, but in later centuries probably the best use it has served is as a nucleus around which Dr. Cholmeley has gathered much interesting historical matter, very aptly and pleasantly put together. The original John is poor stuff. His editor respectfully offers to him some tribute, asking us to recognise at least his clinical insight. John, who died in 1361, highly educated at Oxford and in later life a fashionable Court physician, enjoyed great advantages of experience, and no doubt brought these advantages to the construing of his Oxford "Theoretica" and "Practica"; but his own contributions were exiguous. Arderne, if no great author, was at any rate superior to John of Gaddesden, and we hope that the success of this edition may tempt Dr. Cholmeley to follow up Mr. D'Arcy Power's pioneer work with a like volume on Arderne.

In studying the writings of early physicians we must continually remember that literary ethics was not born until modern times—almost in our own day. It is scarcely fair to these old men, when they lifted pages upon pages from their forerunners, to accuse them of "shameful plagiary." They all did it, and not in medicine only; and not only the inferior authors, but the most reverend of them also. So John, with a pious obsequiousness, helped himself to what he could find elsewhere to serve his purpose. As a specimen of John's wonderfully vivid clinical pictures, Dr. Cholmeley quotes his description of obstructive jaundice with ascites. It is vivid, no doubt; but we may be sure that it is not John's. To track out the sources of all or many of his purple patches would be a long business, but in respect of this passage, as Avicenna lay near me, I looked up this subject therein; I did not find there this paragraph as a whole, it is true, but I found every or almost every sentence of it in Avicenna (Lib. iii., Fen 14, Tr. 4), sentences condensed either by John himself or by someone whom John copied. And thus, with a little trouble, I suspect we might run to earth most or all of John of Gaddesden's clinical equipment. I turned to Avicenna remembering that Razes diagnosed ascites by fluctuation and percussion.

It is not quite easy to account for the sterility of Great Britain in medicine, as in much other knowledge, during the fourteenth and early fifteenth centuries. Gaddesden's book must have been written before the Black Death. Edward the Third was an accomplished sovereign, and England was not more harried by wars than France, yet we have nothing distinguished to show before the time when began the great procession of Gilbert, Clowes the elder, Harvey, Glisson, Wharton, Willis, Lower, Wiseman, Mayow, to prove that Englishmen were capable of carrying the banner of medicine as high as their neighbours. Before the revival it is true that England was somewhat isolated from the main streams of European learning. Anyhow, the history of medicine in England before the accession of the Tudors is a dreary study.

We know how well equipped in the fourteenth century Merton was, or ought to have been, in this field; and Gaddesden was of Merton. Perhaps no faculty has been so robbed of its endowments as medicine; witness also the Linacre trusts and the Gresham College; moreover, of the three "philosophies," the natural branch was gradually eliminated. It is interesting to learn, however, from Dr. Cholmeley that John was a graduate in medicine. I am not sure if Dr. Cholmeley has any higher authority for this title than Wood, to whom he refers. In Cambridge we have little record, if any, of actual M.D.'s before the sixteenth century; and the early statutes, which may be cited as evidence of study for the degree, are (as in Peacock) of uncertain date. Of course, it is probable that in both universities physicians then graduated as M.D.; but are the graduations on record? The "clerks" who studied medicine, at any rate if in orders, seem not to have taken the title of M.D. I ask this as Dr. Cholmeley has added to this book a very interesting narrative of medical education in Oxford. With a true intelligence he has done what was possible to trace the titles of books on medicine then in the University; for in the Middle Ages books were as much the cause of a university as teachers. The author says that Montpellier at that time outshone Oxford as a medical school; the reason, or one reason, is that the libraries of Montpellier were fed from Cordova. Thus also Frederick the Second wisely commended his foundation at Naples by purchasing books for large sums from the Grand Trunk.

Dr. Cholmeley has another interesting chapter on the medieval physician, and others on kindred subjects, for which we thank him cordially. We wish Dr. Cholmeley health and leisure to extend his gifts to us of like scholarly volumes on other chapters of the history of medicine.

Clifford Allbutt.

THE STRUCTURE AND BIOLOGY OF THE BACTERIA.

(1) *Die Zelle der Bakterien.* Für Botaniker, Zoologen und Bakteriologen. By Prof. Arthur Meyer. Pp. vi + 285 + plates. (Jena: Gustav Fischer, 1912.) Price 12 marks.

(2) *Bau und Leben der Bakterien.* By Prof. W. Benecke. Pp. xii + 650. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 15 marks.

THESE two works are evidence, if any be needed, of the increasing interest which is being evinced in the study of the bacteria by biologists. The literature concerning them has now become so extensive that summaries such as are contained in these two volumes are very welcome.

(1) The first book treats almost exclusively of the structure and elements of the cells of the micro-organisms classed by Migula under the Eubacteria. The cells of most of these organisms are so minute that it is only by the employment of the most refined methods of research that their intimate structure and the nature of their cell-contents can be elucidated. The introductory portion deals with the classification of these organisms and with their affinities with other unicellular vegetable forms and with the Protozoa. The author considers that the Eubacteria are closely related to the Hemiascomycetes and Euascomycetes of the fungi. Successive sections deal with the structure and elements of bacterial cells—nucleus, plasmodia, cytoplasm, flagella, membrane, vacuoli, and reserve material. In each section the work of various investigators on the subject is summarised and criticised with commendable completeness. In a final section the question of the chromophyllous nature of the colouring matter of the "purple" bacteria is discussed.

For the specialist who requires a general summary of what is known respecting bacterial structure, no better book could be found. It is profusely illustrated in the text, and contains one coloured plate showing the elements and structures brought to light by the application of various methods, staining agents and other reagents. A full bibliography is appended, but an index is lacking, which is a great mistake.

(2) The second volume is one more adapted to the needs of the biologist or of the general reader, inasmuch as it gives a general survey of the structure and functions of the bacteria and of their activities. The first two chapters are devoted to a consideration of the size, form, development, and occurrence of the bacteria and to the methods employed in studying and cultivating them. Chapters iii.–vi. deal with their morphology and the structure of the bacterial cell. As regards classification (chapter vii.), the author divides bacterial organisms into two suborders, the Haplobacterinæ and the Desmobacterinæ, the former including the single-celled bacteria, the latter the thread-forming organisms such as Leptothrix, Crenothrix, Cladothrix, and Beggiatoa. As an appendage of the Haplobacterinæ he recognises the Mycobacteriaceæ ("Pilzbakterien"), in which he places such organisms as the tubercle bacillus and Actinomyces, and the Myxobacteriaceæ or "slime bacteria." Truly the classification of the bacteria is still in a very unsatisfactory condition!

Variation and mutability among the bacteria are discussed at some length, after which the conditions of life and general physiology of the bacteria are dealt with: assimilation and dissimilation, fermentation, nitrogen fixation, &c. Finally, the occurrence and distribution of bacteria on the earth's surface, in arable, grass, and wooded lands, in water and dwellings, are considered. The book is exceedingly well conceived, and contains a mass of trustworthy information with sufficient references to the literature. It is well printed and illustrated, and is supplied with adequate indexes to the matter it contains and to the authors mentioned.

R. T. HEWLETT.

OUR BOOKSHELF.

Guide Scientifique du Géographe-Explorateur. By P. Crépin de Beauregard. Pp. x+250+2 plates. (Paris: Gauthier-Villars, 1912.) Price 10 francs.

THIS work is not intended for the ordinary traveller who wishes to prepare a sketch-map of the country which he traverses, and to determine with moderate accuracy the position of his halting places. M. Crépin de Beauregard, who has had much experience of surveying both in France and in Indo-China, has prepared a handbook for the trained surveyor who has a certain knowledge of mathematics and has to undertake work of considerable accuracy in new countries in order to provide a control for subsequent topographical surveys. The treatment is consequently in a large degree theoretical, though actual examples from work in the field are given, but the simpler and less precise methods of topographical surveying are not included.

The first chapter deals mainly with the trigonometrical formulæ involved, while in the second the theodolite is discussed as being the instrument employed, and the errors introduced by dislevelment, &c., are investigated. Coming to the astronomical determinations which the surveyor requires to make in the field, the most suitable methods of determining the local time, the latitude of a station, and the azimuth of a mark are fully discussed theoretically, and an example of each is worked out. In these cases each observation made is worked out separately and a mean value of the results is obtained, though the probable error is not considered.

In that part which treats of triangulation the author deals with the computations which are necessary in first and second order triangulation where the surface is treated as that of a spheroid, and in third order work where spherical formulæ suffice. Map projections occupy a chapter, and these are not limited to those types which are likely to be employed by those who are surveying a new country, but include all the principal types. The book should be of much use to those trained surveyors who are steadily extending the network of triangulation in Algeria and Tunis, in Indo-China and Madagascar. H. G. L.

Introduction to the Rarer Elements. By Philip E. Browning. Pp. xii+232. Third edition. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1912.)

To this edition of Dr. Browning's book several additions have been introduced and numerous changes made. The chapter on qualitative analysis has been enlarged by the inclusion of new diagrams, new material has been added to the chapter on technical applications, and a table of spectroscopic lines and plates showing typical spectra have been introduced. The second edition was reviewed in NATURE of April 15, 1909 (vol. lxxx., p. 182).

A First Book of Electricity and Magnetism. By W. Perren Maycock. Fourth edition. Pp. xxii+351. (London: Whittaker and Co., 1913.) Price 2s. 6d. net.

THE first edition of Mr. Maycock's little book was reviewed in the issue of NATURE for January 14, 1892 (vol. xlv., p. 248). The present issue has been revised thoroughly and enlarged considerably, and the author has been successful in his desire to "carry the reader over the threshold of a subject whose theoretical and practical extents are very far-reaching."

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Radio-Elements and the Periodic Law.

I AM grateful to Prof. Schuster for the opportunity he has afforded by his letter (NATURE, March 13) for the discussion of the wide generalisations that have been made with regard to the position of the radio-elements in the periodic table, consequent on the recent experimental work of A. Fleck and of the theoretical suggestions of A. S. Russell and K. Fajans. The whole question is one in which it is important that there should not be any doubt as to the real nature of the evidence adduced. Prof. Schuster's criticism of my views on the subject could scarcely be more sympathetic or helpful, and can only result in a maturer outlook on this important question.

Granting for the sake of argument the possibility of the existence of groups of elements not necessarily of identical atomic mass, with identical chemical properties and spectra, the only known direct manner in which the existence of the members of these groups could be separately recognised is radio-active evidence, in which one member is formed from another, not directly, but through the intermediary of other elements, possessing, necessarily as now appears, completely different chemical properties. Hence it is natural that at first direct evidence should be confined practically to the subject of radio-activity, and much depends upon whether that evidence is considered real evidence approaching experimental proof, or whether it is regarded as merely negative in character.

In the first place, I admit when I wrote the expression, "non-separable by any known process," I had in mind chemical processes. It is unusual and illustrative of the peculiarities of the problem that the relatively rough and partial means of physical analysis, to which Prof. Schuster refers, may be expected ultimately to succeed where the most refined and delicate methods of chemical analysis may be expected to fail. But so it is, and I agree with Prof. Schuster that it should ultimately be possible partially to separate by purely physical methods certain members of these chemically identical groups by virtue of the slight differences in their molecular masses. In fact, a year ago I commenced an experiment to try to effect a partial separation of the two uraniums by diffusion in solution. This case is an exceptionally favourable one as an alteration in the relative concentration of the two uraniums by only a few per cent. should be detectable without any uncertainty by radio-active methods.

Although the term "non-separable" I think connotes present inability, without implying, necessarily, anything as regards what may be possible in the future, I do, however, think that there are good grounds for believing that the *chemical* non-separability of elements occupying the same place in the periodic table is due to the general character of chemical methods rather than the state of refinement and delicacy attained at any particular time. The chemical analysis of matter has given us the periodic law, and there is no case known of two or more ordinary elements with claims to the same place in the periodic table. In this connection the case of the rare-earth group of elements is necessarily excluded, as these elements certainly do not obey the law without modification. In all other parts of the table the rule is that there is only one element for each place, and each place signifies a separate chemical type differentiated in a regular manner from its neighbours. But now the radio-active series have shown that different elements, not necessarily of identical atomic mass, do occupy the same place, and that when this occurs these elements possess identical chemical nature. It is therefore an inference supported by the known facts of chemical analysis that the single place in the periodic classification represents the limits of the analysis of matter by chemical methods, rather than the ultimate analysis into homogeneous types, such as is usually implied in the conventional view of elements.

Prof. Schuster admits that the chemical properties of these non-separable groups of radio-elements are probably more nearly equal than those of the longer-known elements, but claims that there is a vast interval between "very similar" and "identical." I do not like the term "very similar." It is ambiguous, and may mean nothing more than that the experimental examination has been neither skilled nor exhaustive enough to disclose the differences, if any exist. Unless this is the case, I feel that the proper term to use is "identical." Otherwise the word "identical" ought to be expunged from scientific language altogether. Unless there is some reason to foresee a qualification being required by the further progress of knowledge, a definite statement ought to be preferred in science to an ambiguous one, which on account of its vagueness must necessarily remain true for all time. Scientific statements can only express present knowledge, including in this term reasonable inferences from the whole field of such knowledge.

The term "chemically identical" has not been applied until after an examination, not, of course, in every case, but in every possible case, and in sufficient numbers of cases to reveal the general law, as skilled and exhaustive as the present art of chemical analysis allows, and, what is equally of importance, by the use of methods for detecting changes in relative concentration as delicate as any that exist. The example quoted of praseodymium and neodymium ought to be more closely examined. These elements proved to be separable as soon as optical methods of revealing their separate existence became known. In the case of the radio-elements the separate radio-active nature of each individual of the group is exactly known, the proportion of each in any mixture can be quantitatively evaluated. Yet they are non-separable. That some mixture to-day may still be classed as a homogeneous element because no means exist for the separate identification of its components does not affect the fact that some mixtures of elements capable of separate identification are chemically non-separable.

Difficulties of chemical analysis are often not connected with the methods of separation at all, but with the means of determining whether or not a separation has been effected, which, in the case of the difficult rare-earth group are relatively crude and sometimes misleading.

The suggestion, that in the disintegration process a mass equal to that of the α particle previously lost may be picked up, is not a probable one, but even if it is admitted, and it is supposed that parent and product have the same mass, it does not affect the view that they are two absolutely distinct types of matter, disintegrating at different speeds and in certain cases with expulsion of different kinds of rays. The attempt to meet this by supposing that the particular instability which determines their future may depend on their past is equivalent to admitting the essential difference between the two types. Besides it can be stated definitely that for any one kind of instability, or for any one radio-active change, the past exercises absolutely no influence upon the events of the future. The period of average life of an atom depends neither upon how long it has already been in existence nor upon any other known condition. It is independent of concentration or the environment in which the atom disintegrates. These features of radio-active change are against the view that anything of the nature of atomic synthesis is going on concurrently with the disintegration, or that disintegration is conditioned by the drain of energy from the atom by radiation, as is so often affirmed.

The mass of evidence that has been accumulated that different elements have identical chemical nature is not accurately described as purely negative in character. The statement that A is non-separable from B is negative in form only. It contains explicitly an infinite number of definite positive statements that A is separable from C or D, or any other of the hundred or more known elements, or any conceivable mixture of them, by chemical methods, which are exactly indicated by the statement. It is not necessary that A and B should in every case coexist, though in certain cases—the two uraniums is a good example—they have never been obtained apart. Mesothorium-II. ordinarily occurs free from actinium, and the putting in of the latter substance is a voluntary experimental device to show that once mixed these two elements are chemically non-separable. The complete chemical nature of either, or of any other of the radio-elements, could be described in detail *ab initio,* but the negative form is brief and complete.

I do not think there are weaknesses in this part of the argument. It has been a slowly growing theoretical development, and I do claim for it something approaching experimental proof.

As regards the view that chemically identical groups of elements have the same spectrum, this admittedly I put forward on a single case, that of ionium and thorium. It rests entirely on the validity and generality of the α and β ray change rules, but, if these are true, ionium must be the direct product of uranium-II.; its period cannot be less than 100,000 years, and its proportion in the preparations spectroscopically examined less than 16 per cent. and 10 per cent. respectively. Any other view requires the assumption that one or more α ray and twice as many β ray changes remain to be discovered in the series, and it can be stated with some certainty that no such changes remain unknown.

Frankly, I do not expect Prof. Schuster or anyone else to accept a view of this kind, put forward on a single thread of evidence. The value of the view is merely that it suggests definite new lines of work, difficult and costly, but still experimentally feasible.

Prof. Schuster points out that the members of the thallium group, for example, ought to give the thallium spectrum in absence of thallium in the material. The latter condition is easy to ensure. But the case is not a very favourable one on the radio-active side, as thorium-D, the best example of the group to select, has a period of average life of only 4·5 minutes. The case, however, might be within the resources of some radium institute.

Since Prof. Schuster made this suggestion, I have gone into the experimental feasibility of getting evidence of this kind, and have decided to concentrate on the case of thorium-X, the spectrum of which should be identical with that of radium. It is a particularly crucial case. The spectrum reaction of radium is excessively delicate, and the amount of this element can be easily evaluated in quantities thousands of times less than can be spectroscopically detected. The chemical work is complicated, but really exceptionally favourable and elegant.

Mesothorium-I. is non-separable from radium, and radiothorium from ionium, the parent of radium, so that if radiothorium is grown from ionium-free mesothorium it can be purified from radium to any extent and left to produce thorium-X. Naturally, however, the work will require some years, but it should be within the resources of the individual investigator. At the same time, it will be possible to try during the course of the work a large number of similar cases, if a sufficient supply of the primary material, mesothorium-I. can be obtained. This inference as to the spectra is purely a personal view, and is to be taken merely as a suggestion until further evidence is forthcoming. But I would not have made it if I thought it inconsistent with any known evidence.

FREDERICK SODDY.

Physical Chemical Laboratory, Glasgow University, March 15.

An Unknown Assyrian Antelope.

MY attention has been directed by the Rev. A. Paterson to a plate in a portfolio of photographs from Assyrian bas-reliefs published at Haarlem, but now out of print. This plate represents a bas-relief in the great hall of Sinnacherib's palace at Nineveh, and consists of an upper and a lower portion. The latter depicts the monarch in his chariot, while the upper shows a reed swamp with wild animals. This swamp is believed to be part of a pleasure-ground made by Sinnacherib in the neighbourhood of the palace, into which wild animals were turned. It is divided in the bas-relief into an upper and a lower portion. In the left-hand corner of the lower half is shown a wild sow with a litter of young, as they might appear at the present day in the reed-brakes of the Euphrates. The other animals are three ruminants, about half as big again as the sow, but with longer legs. The two in the upper half of the scene — of which one is lying down—are hornless, and therefore females, but the third, in the right-hand corner of the lower half, carries spirally twisted horns, recalling those of the African kudu, nyala, and situtunga, although not corresponding exactly in curvature with any of them. The tail is relatively short, as in the nyala. The buck is represented with its head down, nibbling the stem of a reed; on its body, in addition to parallel lines representing the ribs, are certain patches, which may be intended for broken pieces of reeds. These animals have been regarded as deer, but the buck carries horns, and not antlers, and antlered deer are not inhabitants of reed-brakes. On the other hand, such situations are the resort of several African antelopes, notably the situtunga, and it therefore seems prac-

The male antelope in the bas-relief of Sinnacherib's Swamp at Nineveh.

tically certain that the ruminants represented in the sculpture are antelopes. They must, moreover, be antelopes of an African type, as there are no marsh-haunting species with spiral horns known from Syria, or Asia in general, and the presumption is that they represent an extinct member of the tragelaphine group allied to the nyala and situtunga, in which the females are hornless. The tragelaphine group is represented at the present day in India by the nilgai and chousingha, in which the horns of the bucks are small, but there is evidence that in the Pliocene India was the home of species akin to the kudu and bush-buck. And it is therefore quite reasonable to expect that in Assyrian times a member of the group may have inhabited the Euphrates Valley.

R. LYDEKKER.

Cavities in Stones.

IN the description of the Agglestone "on the old moor of Studland, near the north shore of the Island of Purbeck," given in Warne's "Ancient Dorset," allusion is made to superficial cavities or hollows in this stone, and in stones in Yorkshire and Lancashire. In some cases "the cavities consist of holes about an inch and a half broad and of the same depth drilled into the stone." Mitchell[1] gives illustrations of the stones with cup-shaped markings described by Sir James Simpson in his work on "Archaic Sculptures."

In all probability these examples of supposed archaic sculptures (and others) have long ago received the "more extended investigation by competent observers" that Warne thought they deserved. But it would be of interest to know if they have been examined by conchologists as well as archæologists. There is just a possibility that some may be burrows excavated by *Helix aspersa*, for the description and illustrations recall the helicidean cavities in Carboniferous Limestone that occur somewhat frequently in Ireland, but are uncommon in Britain. The rock-shelters of *Helix aspersa* at Great Orme's Head, Llandudno, and at Miller's Dale, Derbyshire, have been fully described and illustrated,[2] also others more recently observed by myself in the limestone on Brean Down, Weston-super-Mare.[3]

E. W. SWANTON.

Sir Jonathan Hutchinson's Educational Museum, Haslemere, March 10.

An Experiment for Showing Lines of Force in an Electrostatic Field.

A GILT cork ball, about 1 cm. in diameter, is attached by sulphur to a vertical straw about 28 cm. in length. The lower end of the straw is fastened by sulphur to the centre of a circular cardboard tray about 5 cm. in diameter, in which is a ring of lead. The tray is put on a watch glass which floats on the surface of mercury in a large flat dish. (A developing dish about 30 cm. by 26 cm. was used, but a shallow wooden trough made for the purpose would be better.) In this way the gilt ball is able to move fairly freely in a horizontal plane. This float arrangement is kept in a bell-jar desiccator when not in use.

Two conducting spheres, about 10 cm. in diameter, are mounted on vertical glass tubes (sealed off at each end), and coated for about 10 cm. with sulphur, which can be readily got into a good insulating condition when required by warming in a flame. The centres of these spheres and the gilt ball are at the same level. The spheres being arranged on opposite sides of the dish, and so that the ball can touch them.

The spheres are connected either to the same terminal or to the opposite terminals of a Wimshurst machine.

The gilt ball describes curves which, when it moves slowly, give the general directions of the lines of force between the spheres in the plane it is free to move in.

The experiment is effective for illustrating lines of force in an electrostatic field and for leading up to the mathematical definition of potential. It may be extended for different charges on the spheres.

R. F. D'ARCY.

Caius College, Cambridge.

Units of Pressure in Vacuum Work.

SURELY physicists do, or should, for convenience, always express wave-lengths in microns (μ) and molecular distances in millimicrons ($\mu\mu$). Why not follow the same practice in dealing with vacua? The millimetre is a convenient unit down to, say, 0·1 mm., but 1/1000 mm. and 1/10,000 mm. have frequently to be expressed. It is simpler to write and comprehend these in the form 1 μ or 0·1 μ. Again, in the pamphlet sent out by Dr. Gaede to describe his very successful pumps, we see unwieldy decimal expressions used. For instance, it is stated that it is possible to obtain a pressure of 0·000002 mm. of mercury after four minutes of pumping. Why not write this 2$\mu\mu$ of mercury?

There is a small unit sometimes found in researches, viz. one-millionth of an atmosphere, denoted by the letter M, but for this unit to have a definite numerical meaning it is necessary to quote the barometric reading at the time. If the barometric reading is normal 1 M=0·76 μ. But, of course, 0·76 μ alone needs no qualifying as to the barometric pressure, and therefore is simpler and more direct.

P. E. SHAW.

University College, Nottingham, March 2.

NEW MICROSCOPE EYEPIECES.

Eyepiece Micrometer.

DR. METZ, one of the researchers employed in the Leitz optical factory at Wetzlar, has recently described[1] a micrometer for use with the microscope which, if we are not mistaken, will rapidly replace all others, including the expensive filar micrometer where a mechanical stage is available. The root idea is that the scale used is such that microns can at once be read off without greatly changing the tube-length, or considering the micrometer value of the objective employed, and therefore dispensing with the arithmetic for which this is a necessary datum.

To bring this about, the intervals of the new scale, instead of being 1/10 or 1/20 mm. wide, as is usually the case in eyepiece micrometers, have a definite value of 0·06 mm.

With an objective of 2 mm ($\frac{1}{12}$) focus when a stage micrometer with ten $\frac{1}{100}$ mm. divisions is viewed, each of these divisions falls on the larger

[1] "The Past in the Present," p. 86.

[2] John Taylor, "Monograph of the Land and Freshwater Mollusca of the British Isles," vol. i., p. 311, fig. 601, and vol. iii., pp. 244–246.

[3] E. W. Swanton, "The Mollusca of Somerset" (Somerset Arch. and Nat. Hist. Soc., 1912), pp. 26, 27, pl. iii.

[1] *Zeit. für wissenschaftliche Mikroskopie*, xxix., p. 72.

divisions of the eyepiece micrometer indicated by the steps (see Fig. 1). Each of the smaller divisions therefore represents a micron.

If exact coincidence between the eyepiece and stage scales does not occur with the proper tube-length, it should be varied—a slight variation is all that is necessary—and the new tube-length recorded for micrometer purposes.

It is obvious that as a 4 mm. ($\frac{1}{6}$) objective has half the magnification of one with a focus of 2 mm., such an objective treated the same way will give us the ten divisions of the stage micrometer covering five of the large divisions of the eyepiece micrometer; hence to obtain microns we must multiply by 2, and this is all the arithmetic needed.

It also follows that with an 8 mm. ($\frac{1}{3}$) we must multiply by 4, and with a 16 mm. ($\frac{2}{3}$) by 8, to obtain the number of microns subtended by each of the smallest divisions of the eyepiece micrometer.

It will be seen then that one of the results of the new departure is to obtain for each objective and for a given tube-length convenient, and in the majority of cases integral, micrometer values, which greatly facilitate the use of the instrument. The actual tube-length differs in most cases but little from the standard length.

Dr. Metz in his paper gives the value of the unit of the scale and the proper tube-length to be used with each of the twenty-four of the achromatic, fluorite and apochromatic objectives produced by the Leitz firm.

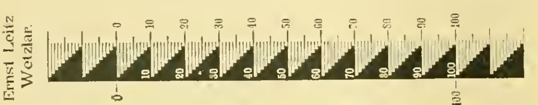


FIG. 1.—Micrometer scale showing steps.

But, of course, the new micrometer can be used with any objective, and for general purposes it will be employed with objectives having foci of 2, 4, 8, or 16 mm. focus. These we have already considered.

The following table gives the tube-length results obtained in a trial of the new micrometer with objectives of different makers; it will also show the wonderful simplicity brought about:—

Focal length mm.	in.	Maker	Tube length for best definition	Tube length for scale coincidences	Scale divisions equivalent to $\frac{1}{10}$ mm.	Multiplier to obtain microns (μ)	One division of the scale $=\mu$
2	$\frac{1}{12}$	Crouch	170	170			
,,	,,	Reichert (dry)	170	190	100	1	1
,,	,,	Watson	200	*172			
4	$\frac{1}{6}$	Bausch & Lomb	160	188	50	2	2
,,	,,	Watson	200	210			
8	$\frac{1}{3}$	Winkel	170	*192	25	4	4
16	$\frac{2}{3}$	Watson	200	193	12·5	8	8

* The variation from the normal tube length in these cases arises from the fact that the $\frac{1}{12}$th is really a $\frac{1}{13}$th, though listed as $\frac{1}{12}$th, and the focus of the 8 mm. examined is really 8·5.

To demonstrate the simplicity of the method and the degree of accuracy to which the step micrometer lends itself, the following examples may be given:—

The object selected was a valve of *Surirella gemma*; its length was measured first by an eyepiece micrometer of the usual type and then by the step micrometer.

(1) Leitz objective $\frac{1}{6}$ in., possessing micrometer value 0·00349 mm., length of valve 30·9 intervals of the scale; therefore $30·9 \times 0·00349 = 0·1078$ mm. $= 107·8\ \mu$.

With the step micrometer the value of the same objective is 2 μ at a mechanical tube-length of 178 mm., the valve covers 53·8 intervals of the scale; therefore $53·8 \times 2 = 107·6\ \mu$.

(2) Leitz objective $\frac{1}{12}$ in. oil immersion, micrometer value $= 0·00164$, length of valve 65·5 intervals of the scale; therefore $65·5 \times 0·00164 = 0·1074$ mm. $= 107·4\ \mu$.

With the step micrometer the same objective possesses a micrometer value of 1 μ at a mechanical tube-length of 168 mm., the valve covers 107·5 intervals of the scale; therefore $107·5 \times 1 = 107·5\ \mu$.

In certain cases of frequent occurrence the use of the eyepiece micrometer involves difficulties. The usual eyepiece micrometer has very fine lines, and with some objects it is difficult to see them under unfavourable conditions of lighting. During prolonged observations with an eyepiece micrometer this is very fatiguing and apt to strain the eye.

This defect is particularly pronounced when an object and a micrometer scale are seen by dark-ground illumination, a method which is now largely employed. Indeed, in a dark-ground field the micrometer scale may refuse to come into view.

In the new micrometer the intervals are arranged in groups or steps of ten, each group being indicated in an unmistakable manner by a black echelon rising from the first to the tenth interval. This arrangement possesses the great advantage that the divisions can always be seen distinctly whether the objects be light or comparatively dark.

The micrometer is mounted on the diaphragm of the eyepiece, and can be sharply focussed with the eye-lens, which is mounted in a sliding sleeve. The device is made by E. Leitz, and its cost with eyepiece is fifteen shillings.

Double Demonstrating Eyepiece.

Next in importance to the new micrometer comes a form of eyepiece, introduced also by the firm of Leitz, which enables two observers to use the same objective, and therefore to view the same object. It is called a double demonstrating eyepiece, as no doubt its chief, though not its only, use will be to serve a demonstrator to instruct a student.

The new eyepiece slips into the draw-tube of the microscope like an ordinary eyepiece. The field of view is common to both eyepieces, and contains a pointer which either observer can direct upon any feature to which he wishes to direct attention.

The arrangement of the device is shown in the subjoined figure:—

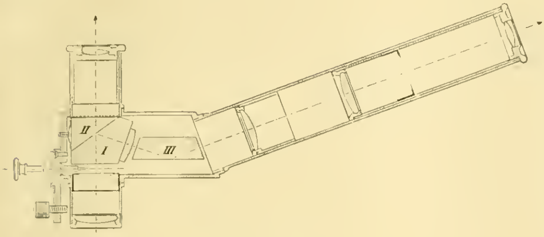


FIG. 2.—Demonstrating eyepiece.

I and II are two prisms in contact and mounted above the diaphragm between the field-lens and the eye-lens of the eyepiece. The prism I has an isosceles cross-section, and its angles are 35°, 35°, and 110° respectively. The prism II is rectangular, and its angles are 35°, 55°, and 90°. The prisms are placed with those faces in contact which subtend the angles of 90° and 110° in such a manner as to leave between them a very thin film of air. This film is inclined at an angle of 30° to the axis of the eyepiece and partially reflects the emerging pencil of rays; about two-thirds of the rays pass through the prisms, and one-third is reflected.

The image formed along the axis of the microscope is accordingly brighter than that produced by partial reflection. The centre line of the reflected pencil is inclined at an angle of 70° to the axis of the microscope. III is a prism the lower surface of which reflects the pencil upwards at a convenient angle for observation. In order that the two observers may not be in each other's way, the branch tube is fitted with a system of lenses which resembles a terrestrial eyepiece. The image as seen in the side tube is reversed with respect to that which appears in the axial eyepiece; but this scarcely affects the observer, since the oblique attachment of the side eyepiece changes the orientation of the field which is focussed through the principal eyepiece, as the image seen through it is brighter. The adjustment for one eyepiece furnishes a clearly defined image in the subsidiary eyepiece, provided the eyes of both observers can accommodate in a similar manner. The objective in conjunction with the field-lens below the double prism of the two eyepieces forms an image in the plane of the diaphragm below the double prism. This image and the pointer, being both in the plane of the diaphragm, are seen simultaneously in both eyepieces. The pointer can be moved backwards and forwards and turns on a pivot so that its extreme end can be set to any point in the field.

The new eyepiece is well adapted for the instantaneous photography of living bacteria and other moving organisms illuminated by means of a dark-ground condenser; it enables one to observe the object through the side eyepiece and to defer the exposure until a favourable moment presents itself.

This eyepiece makes the instrument to which it is attached into a binocular microscope in a new sense. Its use will certainly not be confined to laboratories; it will equally be a delightful acquisition to tyros discussing pond-life or other subjects in which amateurs take an interest. The 6-diameter power is to be preferred, and as the branch tube is not counterpoised, if the eyepiece tubes do not fit tight it is better to use the microscope in a vertical position.

STANDARDS AND TESTS FOR SEWAGE AND SEWAGE EFFLUENTS.

THE eighth report of the Royal Commission on Sewage Disposal deals with the important question of standards and tests for sewage and sewage effluents discharging into rivers and streams. In their fifth report the Commissioners indicated the desirability of fixing a legal standard for sewage effluents, and suggested that such a standard should be based on (i) suspended solids and (ii) absorption of dissolved oxygen. Their contention then was that the two tests should be taken separately, and they suggested three parts per 100,000 as the limit of suspended solids, and that the effluent after removal of its suspended solids should not absorb more than 0·5, 1, and 1·5 parts dissolved oxygen per 100,000 after one day's, two days', and five days' incubation at 65° F. respectively.

In their present report the Commissioners recognise the difficulty of the separation of the suspended solids, and finally recommend the following as the normal legal standard, viz.: 3 parts per 100,000 of suspended solids, and, including its suspended solids, the effluent shall not absorb more than 2 parts dissolved oxygen per 100,000 after five days' incubation at 65° F.

The importance of this report lies in the fact that not only is a definite legal standard recommended, but that in the opinion of the Commissioners this standard should be a variable one, dependent on the conditions at the outfall, *i.e.* condition of river or stream receiving the effluent and relation of volume of sewage effluent to river water.

The Commissioners state that their experience leads them to think that if the dilution while not falling below 150 volumes does not exceed 300 volumes, the dissolved oxygen test may be omitted and the standard for suspended solids fixed at 6 parts per 100,000, and if the dilution while not falling below 300 volumes does not exceed 500, the standard for suspended solids may be further relaxed to 15 parts per 100,000, and with a dilution of more than 500 volumes all tests might be dispensed with and crude sewage discharged, subject to such conditions as to the provision of screens or detritus tanks as might appear necessary to the central authority.

In arriving at the proposed legal standard and modifications, the limit of the amount of dissolved oxygen absorbed by river water without creating a nuisance has been taken as a basis. The report contains data in regard to this point, and the method of determining the standard so far as regards the permissible amount of dissolved oxygen absorption is given. Tables are also given showing the amount of oxygen absorbed by typical sewage liquors and effluents, together with the theoretical amount of dilution necessary to prevent de-oxygenation beyond a certain limit.

E. A.

BIRTHMARKS AS A TEST OF RACE.

A SUGGESTION was recently made by Herr Bealz that blue patches in the sacral region furnished a valuable test of race. Such marks are found among the children of Chinese, Koreans, Japanese, and Malays. Mr. Gait, Census Commissioner for India, directed that during the 1911 census inquiries should be made into the question. Much information on the subject will be found in Mr. C. M. Webb's Census Report of Burma for 1911, recently issued (vol. i., pp. 281 *et seq.*). The results are not decisive, and there are at present no means of giving statistics showing the prevalence of these marks. But they are found extensively in Burma, and seem to indicate the existence of a Mongoloid strain in the population.

The question of Melanoglossia was also raised by Surgeon-Captain Maynard, I.M.S., and the prevalence of these black marks on the tongue was also investigated by Mr. Webb (*ibid.*, i. 286), They are very infrequent among Aryan immigrants to Burma, but are found to a large extent among Dravidians, and the pigmentation of the tongue seems to vary with the pigmentation of the skin.

It may be hoped that the question will receive further attention in India, and that inquiries will be made on a wider scale to determine the statistical incidence of these marks.

COLONEL J. S. BILLINGS, M.D.

THE world of letters, as well as that of science, has sustained a very great loss in the death of Col. J. S. Billings, M.D., who died in New York on March 11, at the age of seventy-six. Although born in Indiana, and not in New England, he was nevertheless a typical example of what Oliver Wendell Holmes in "Elsie Venner" calls "the Brahmin caste of New England." In person he was tall and powerfully built. He had a well-poised and shapely head, clear-cut features and a very quiet, unassuming and courtly manner.

In spite of his quiet appearance and manner, Dr. Billings was a man of extraordinary energy. He joined the army of the Northern States in 1861 as assistant surgeon, but he was medical inspector of the army of the Potomac when the war finished. During the war he designed most of the hospitals of the northern army. In 1883 he took charge of the Surgeon-General's Library at Washington, a small collection of about two hundred books. During the twenty-two years in which he held the office of director he raised this collection to be one of the finest medical libraries in the world. The catalogue of the library is a stupendous work, giving references not only to medical books, but to pamphlets and extracts, so that it is now indispensable to every worker in medical literature.

From 1891 to 1896 Dr. Billings was professor of hygiene in the University of Pennsylvania, and in 1896 he became director of the New York Public Library, Astor, Lenox and Tilden foundations. This he determined to make one of the seven or eight great libraries of the world, comparable with the British Museum and the Vatican Libraries. He had the satisfaction during his lifetime of seeing a new building provided for the library and the number and value of the books greatly increased. In addition, he arranged for branch libraries to which books could be sent out and consulted apart from the library itself.

Probably no other single man ever did so much for libraries as Dr. Billings. His work was recognised during his lifetime by various universities. He received the honorary degree of LL.D. from five universities—Edinburgh, Harvard, Buda-Pesth, Yale and Johns Hopkins—the D.C.L. from Oxford and the M.D. from Munich and Dublin. But his labours in founding a complete bibliography of medicine by the Surgeon-General's Catalogue and the "Index Medicus," in devising a new method of library cataloguing, and in extending and amplifying the work of the New York Public Library so as to make it a great national institution, will only be fully appreciated by posterity. His kindness of heart, his affectionate disposition and his charm of manner made him beloved by all who knew him, and it will be long indeed before we see his like again.

LAUDER BRUNTON.

NOTES.

THE Geological Society of France has awarded the Gaudry medal, the highest honour it can bestow, to Prof. Edward Suess, of the University of Vienna. The Fontannes prize for the best work in stratigraphical geology during the last five years has been awarded to M. Jean Boussac.

WE are asked to state that the Committee on Research Institute, Chicago, is collecting information about bibliographical material and indexes kept in manuscript by libraries or individuals. Those who have such material in their possession, or know of the whereabouts of any, are desired to communicate with Mr. A. G. S. Josephson, care of the John Crerar Library, Chicago.

IN accordance with the recommendation of the Royal Commission on Vivisection, the Home Secretary has appointed an Advisory Committee to assist him in the administration of the Cruelty to Animals Act, 1876. The members of the committee, who have been selected from names submitted by the Royal Society and the Royal Colleges of Physicians and Surgeons, are:—Sir Anthony Bowlby, C.M.G., Sir J. Rose Bradford, K.C.M.G., F.R.S., Sir H. Bryan Donkin, Mr. G. H. Makins, C.B., the Lord Moulton of Bank, Dr. S. J. Sharkey, and Dr. C. J. Symonds.

We learn from *Science* that the National Academy of Sciences will hold, on April 22–24, an adjourned meeting to celebrate the semi-centennial anniversary of its foundation. The academy held its first meeting in New York on April 22, 1863. In addition to the American speakers, there will be three speakers from Europe—Prof. J. C. Kapteyn, Holland, on the structure of the universe; Prof. A. Schuster, London, on international cooperation in research; and Prof. Theodor Boveri, Würzburg, on the material basis of heredity.

The Times of March 10 devotes an article to the recent attempts to introduce, as mosquito-destroyers, into various tropical countries, the tiny fresh-water Barbados fish, locally known as "milliones," and the unsatisfactory results by which such attempts have been attended. In India and Burma more promising results, as pointed out in a paper by Capt. Sewell and Mr. Chaundhuri, recently published in vol. vii. of the Records of the Indian Museum, are likely to attend the cultivation in pools and ponds infested with mosquito larvæ of native species of cyprinodonts, such as several of those of the genus Haplochilus.

The founder's royal medal of the Royal Geographical Society is not awarded this year, but, with the approval of the King, a casket with a suitable inscription will be presented to Lady Scott, to contain the patron's medal and the special Antarctic medal awarded to her late husband, Capt. R. F. Scott, in 1904. The patron's medal has been awarded to the late Dr. E. A. Wilson, of the National Antarctic expedition, and a gold watch to Lieut. Campbell, who led the northern party of the same expedition. The Victoria medal is awarded to Col. S. G. Burrard, F.R.S.; the Gill memorial to Miss Lowthian Bell; the Murchison award to Major H. D. Pearson; the Cuthbert Peek grant to Dr. Felix Oswald; and the Back bequest to Mr. W. S. Barclay.

According to a Reuter message from Hobart, the *Aurora*, the ship of the Mawson Antarctic expedition, returned there on March 14, without Dr. Mawson and the party of six who were left with him in Adelie Land. After leaving the six men behind, the *Aurora* left on February 8. Eight hours after her departure a wireless message was received stating that Dr. Mawson was safe, and the latter afterwards himself sent a message instructing the *Aurora* to return to Commonwealth Bay. A hurricane, however, prevented all communication with the land, and the captain left for Wilde's base. The *Aurora* reached Wilde's base on February 23. Mr. Wilde reported that he had taken possession for Great Britain of the whole area of land from Kaiser Wilhelm II. Land to longitude 101° 30′ east, and as far south as 67° 30′. The trend of the land is almost due east and west, and the coast-line almost on the Antarctic circle. The land is named King George V. Land.

At the twenty-second annual meeting of the Royal Society for the Protection of Birds, held at the Westminster Palace Hotel, on March 6, Lord Curzon, as reported in *The Times* of March 7, strongly deprecated the continuance of the practice of wearing feathers (other than those of birds used as food) by ladies, and referred to the appalling slaughter of certain kinds of birds of brilliant plumage. In 1911 his lordship stated that in three sales in London no fewer than 41,000 skins of humming-birds, 20,700 of birds of paradise, and 129,000 egret plumes were sold. After adverting to the fact that the egrets are killed while in the breeding plumage, and that certain species or races of birds of paradise are reported to have been exterminated by the plumage-hunters, the speaker observed that although much had been done to stop the trade, yet there were weak links in the prohibitory chain, among these being the lack of prohibition of the import and sale of feathers and skins in this country.

The International Congress of Historical Studies is to be held in London on April 3–9. The proceedings will consist of general meetings and sectional meetings. Already some 600 members and associates, coming from all parts of Europe, have signified their intention to take part in the proceedings, and delegates from a very large number of universities and learned societies will be present. Readers of Nature will be interested most in the subsection of Section VII (History of Mediæval and Modern Civilisation), which deals with the exact sciences, natural history, and medicine. In this subsection the following papers have been promised:—"The Annals of the Royal College of Physicians in London," Dr. Norman Moore; "Origin and Development of the Compass Card," Prof. Silvanus Thompson; "Scientific Research in the Early Seventeenth Century exemplified by the Life of Peirese," Prof. L. C. Miall; "Aristarchus of Samos," Prof. H. H. Turner; "Newton's Principia" and "Magic," Mr. W. W. Rouse Ball; "The Mathematical Glories of Great Britain," Prof. G. Loria; "Palissy, Bacon, and the Revival of Natural Science," Sir Clifford Allbutt; and "Historical Method in Science," Mr. W. C. D. Whetham. Every person wishing to become a member of the congress is requested to send to the secretary of the congress, Prof. I. Gollancz, The British Academy, Burlington House, London, W., as soon as possible, name, title, office, and postal address; also, the section or sections with which he desires to be associated.

We regret to see the announcement of the death of the distinguished cartographer, Dr. E. G. Ravenstein. For the following particulars of his career we are indebted to an obituary notice in yesterday's *Times*:—Dr. Ravenstein was born at Frankfurt-on-Main on December 30, 1834, and belonged to a family who for many years have been known as cartographers of high rank. He came to England when he was about twenty years of age, and his capacity as a cartographer obtained for him a position in the Intelligence Department of the War Office, which he filled from 1855 to 1872. He had been a pupil of the famous Dr. Petermann, and did much to improve British cartographical methods. For the Royal Geographical Society he devoted several years to the compilation of a map, of many sheets, of eastern equatorial Africa, which was published in 1884; and even now, after all that has taken place in the last thirty years, it is a monument of fullness and accuracy, indispensable to the student of the evolution of African geography. He served on the council of the Royal Geographical Society for several years, and was president of the Geographical Section of the British Association in 1891. Among his publications were "Vasco da Gama's First Voyage," published in 1898; a "Systematic Atlas," 1894; and "Martin Behain, his Life and the Globe," 1908, a monumental work, the result of many years of research.

YESTERDAY was the hundredth anniversary of the birth of Dr. Livingstone, and the centenary has been celebrated by many eloquent tributes to the memory of the great explorer. At a meeting of the Royal Geographical Society on Monday an address on the subject of the life and achievements of Livingstone was delivered by Sir Harry Johnston, and the assembly included not only many distinguished geographers, but also relations and others, who were associated with the great explorer during his life. In the course of his remarks, Sir Harry said that a research into the life and work of Livingstone on which he had been engaged for thirty years past, beginning with his (the lecturer's) association with Stanley, with Sir John Kirk, and some of Livingstone's old Swahili followers on the Congo, left him unable to quote anything of importance which could be regarded as serious dispraise of that remarkable man. On the other hand, the repeated reading of Livingstone's works tended to increase his astonishment at Livingstone's achievements with the means in his possession, and to convince him more than ever that Livingstone was the greatest of African explorers, judged not only by his actual achievements but by his character, disposition, and mental capacity. He wrote things, he expressed ideas, in the 'forties, 'fifties, and 'sixties of the last century which seemed to-day singularly modern as conceptions, conclusions, and lines of profitable study. Indeed, it required very little accentuation of his opinions expressed in private letters in 1841 to formulate the phrase, since so potent, of "the Cape to Cairo." He never lost sight of this ideal, and during his last years speculated on its ultimate achievement through the work of Sir Samuel Baker on the Mountain Nile and the Albert Nyanza. The work done by Livingstone for geographical science and for humanity stands out among the greatest achievements of history; and we are glad to unite with all others who are bearing testimony this week to the noble career of the pioneer who passed away forty years ago, and whose work opened up a continent to civilisation.

THE Chingford reservoir of the Metropolitan Water Board, excellent accounts of which will be found in *The Engineer* and *Engineering* for March 14, was opened by his Majesty the King on Saturday last. The reservoir measures about two miles in length by more than one-third mile in width at its narrowest part, and covers an area of 416 acres; the length of embankment is about four and a half miles. The reservoir straddles the old course of the River Lea, and is divided into two parts by a bank near its centre, in order to reduce the fetch of waves. The embankments consist of a puddle trench reaching down to the London clay, and filled with earth, the outer slope being $2\frac{1}{2}$ to 1, and the inner slope 3 to 1 to 4 to 1. The slopes are faced with concrete slabs, the protection being most complete at the north-eastern corners where the highest waves with prevalent winds may be expected. The reservoir is capable of storing 3000 million gallons, to be pumped from the River Lea, and also from the River Lea Navigation, by means of five large Humphrey gas pumps, reference to which was made in NATURE for February 20 (p. 683). These pumps have been put to work with complete success. The large storage capacity required in the Lea Valley is necessitated by the enormous fluctuations in the volume of flow of the Lea. Much of the capacity will only be required at rare intervals, and in normal seasons will facilitate treatment by subsidence; it has been proved that storage alone affects a marked improvement in the quality of water, and thus reduces the work of the filters.

A LECTURE was delivered at the Galton Laboratory, University College, London, on March 11, by Mr. W. Palin Elderton, on the mortality of the phthisical under sanatorium and tuberculin treatments. Mr. Elderton showed that at present the best comparison is reached by studying the subsequent mortality of those who have undergone various kinds of treatment. The mortality of incipient cases under sanatorium treatment is, generally speaking, more than three times that of the general population, while advanced cases show a mortality of ten times, and far advanced cases a mortality of about forty times that of the general population. He discussed some interesting results from Dr. Lawrason Brown's statistics of the Adirondack Sanitarium, New York, but owing to the selection of patients and the increased proportion of early cases among the patients admitted more recently it is impossible to decide to what extent sanatorium treatment has improved. The statistics show, however, that at this particular sanatorium the authorities are now better able to say which cases will improve under treatment and which cases are cured. Mr. Elderton showed that the mortality of cases having tubercle bacilli in the sputum is two and a half times to four times as heavy as that of the cases which are without this symptom, and this result sometimes enables the extent to be estimated to which data are influenced by the admission of an undue proportion of early cases. There is no evidence to prove, he continued, that tuberculin, as compared with ordinary sanatorium treatment, appreciably lengthens the life of the consumptive. If the use of tuberculin had the marked results claimed by some definite evidence of its effect on mortality would have been anticipated.

MR. O. G. S. CRAWFORD, in the February issue of *Man*, discusses a remarkable funereal vase, now in the Isle of Wight Museum, which was found on Nunwell Down, Isle of Wight. The form and ornamentation of the vase, among those found in this country, are unique, and the nearest analogue to it appears in central Germany, whence it was probably imported. The remains associated with the vase are identified by Prof. A. Keith as belonging to a typical individual of the Bronze age type, a race which probably brought the vase with them from the Continent. This theory is strengthened by the fact that the Isle of Wight lies athwart the path of every invader of Wessex; the island has been, from the earliest times, in close touch with the opposite coast of France, and the Jutes followed the same route as their predecessors of the Bronze age.

To the *Anales del Museo Nacional*, Buenos Aires, vol. xxiii. (incorrectly lettered xx. on side of cover), Mr. F. Lahille describes a new species of malaria-producing mosquito from Tucuman under the name of *Anopheles tucumanus*, and likewise gives a new formula for indicating the wing-venation in this and other members of the group. He also states, in referring to the Argentine representative of *Stegomyia fasciata*, that the alleged sexual difference in the number of joints in the palpæ of that species is incorrect, and that the difference is really due to the extremely minute size of the terminal one in the female, which renders its recognition very difficult.

IN the same volume (*An. Mus. Buenos Aires*, xxiii., p. 269) Mr. Lahille describes, as *Phocaena dioptrica*, a new porpoise from the estuary of the La Plata River. It is described as having the upper part of the head and body, as well as the lips, deep lustrous black, but on the flanks this gives place suddenly to milk-white, which occupies the whole of the underparts, the flippers and a semicircle above each eye being also white. There are sixty-eight vertebræ, and $\frac{20-21}{19}$ teeth. On p. 391 of the volume Mr. A. Gallardo describes a specimen of Fitzroy's dolphin (*Lagenorhynchus fitzroyi*) stranded at Mar del Plata in December, 1912.

To Dr. N. V. Nasonov, director of the museum at St. Petersburg, we are indebted for a copy of a paper on *Ovis arcar* (or *arkar*) and its relatives, published in the *Bull. Ac. Imp. Sci. St. Pétersbourg*, 1912, pp. 1–32, plates i.–v.; the text being, unfortunately, wholly in Russian. Brandt, in 1852, gave the name *O. arkar* (from the Turki designation of all big wild sheep) to the wild sheep of the Ust-Urst plateau, Transcaspia; but in Blasius's "Säugethiere Deutschlands" the name was corrupted into *arkal*, by which title the animal has been almost universally known. Most naturalists regard the arkar as a race of the sha or urial (*O. vignei*), but Dr. Nasonov is of opinion that it should rank as a species, with three local races. One of these, from the Kopet-Dagh, dividing Persia from Turkestan, has been previously named *O. v. varentzowi* by Dr. Sátunin, but the third, which is based on two heads collected by Karelin, it is believed in the neighbourhood of Astrabad, is described as new, under the name of *O. a. dolgopolovi*.

PROF. OMORI, the well-known Japanese seismologist, directs attention in the Tokyo *Asahi* (January 29) to a remarkable coincidence between the frequency of earthquakes as recorded by the seismometer at Tokyo and the amount of rain- and snow-fall in north-western Japan. The relationship is borne out by statistics covering the whole of the Meiji era—forty-five years from 1867. The number of earthquakes recorded annually at Tokyo between 1876 and 1909 is found to be practically in direct ratio to the amount of rain- and snow-fall at Niigata and Akita, on the Japan sea coast. The curves for earthquake frequency in Japan show that these disturbances gradually increase in number over a period of years, and then undergo a corresponding decline, and in accordance with a recognised principle destructive earthquakes are most likely to occur in a period of minimum earthquake frequency. Such minima occurred in 1883, 1893, and 1903, and very violent earthquakes took place in 1884 and 1894. These periods, it is noted, corresponded with a conspicuous freedom from rain- and snow-storms in the north, while in the years of maximum earthquake frequency at Tokio—*i.e.* with no violent shocks—the amount of rain and snow falling in the north was much above the average. No reason for this apparent relationship can at present be assigned.

A NEW form of rain-gauge has been constructed by Messrs. Negretti and Zambra, of Holborn Viaduct, under the directions of Dr. H. R. Mill, of the British Rainfall Organisation, and the instrument has been named the "Seathwaite" rain-gauge. It is designed especially for use at out-of-the-way stations, where the gauge is visited at only long intervals. The registrations it affords will be of great value to science in those districts from which at present rainfall records are scarce, owing to the difficulty of frequent access, and it will probably be greatly appreciated by borough councils, waterworks, and various branches of engineering. The feature of especial interest in the construction is that it collects through a 5-in. funnel, the dimension approved by the British Rainfall Organisation, a large quantity of water, the receiver having a capacity of 30 in. of rain. The advantage over the older types of gauge is effected by enlarging the funnel from the 5-in. rim to a cistern of 8-in. diameter. As a protection against evaporation or frost, the gauge is lined with an insulating material. The measuring apparatus is quite apart from the gauge, and is carried in a small wooden case by the observer. A tentative measurement is first made by means of a graduated cedar rod, which gives approximately the depth of water in the gauge. For the ordinary measurement a dipper, made of copper, holding exactly 5 in. of rain, is used, and for the residue after the several 5 in. an ordinary glass measure is used, graduated up to 1 in. in subdivisions of 0·05 in. The total height of the gauge is 28 in., but only 13 in. remain above ground. The gauge is made of stout galvanised iron. Attention has been given to every detail in construction with the view of securing the greatest possible accuracy and with a minimum of trouble to the observer.

IN the Journal of the Meteorological Society of Japan for November, 1912, we find five articles. The first, by Mr. T. Hirata, is on wind in Korea, and other important meteorological phenomena. The second, by Mr. K. Asakura, is on the Red Stream, or Akashiwo, near Kanagawa. He remarks that in August it was very hot and many fish died, but not so many as in the previous year. Mr. K. Nakamura discourses on the climate in the Bonins, whilst Mr. N. Takenaka gives the results of twenty-seven years' observations in Kyūshū on the velocity and direction of the strongest winds. The only paper published in Roman characters is one by Mr. S. Fujiwhara. Its title is "Periodic Changes of Climatic Elements in Relation to the Oscillation of the Earth's Axis." The first climatic element to which he directs attention is the freezing of a small lake called Suwa, in Central Japan. In the sheet of ice two or three large fissures are usually developed, and there is a belief that this splitting is somehow or other connected with the weather and crops of the following year. For this reason a record has been kept since A.D. 1444 of the first date of the complete freezing up of this lake. These dates, in relation to years, have been plotted on squared paper. The resulting curves show, but not very clearly, a tendency for warm winters to recur every seven years. These curves of freezing are compared with temperature curves at several places in Japan, and curves showing the variation in latitude.

MESSRS. WRATTEN AND WAINWRIGHT, LTD. (Croydon), are issuing a second and revised edition of the descriptive list of their "light filters," which have gained for this firm a world-wide reputation. It includes nearly ninety varieties, each with a statement of its special use, whether in spectroscopy, photomicrography, or the getting of monochromatic light, &c., and its stability when exposed to light. It includes also the photographed absorption spectrum of each filter over a range of light intensities of from one to ten thousand, and the spectrum sensitiveness of the plates that the firm makes. There are filters designed for use with mercury-vapour lamps, passing respectively the yellow, green, and violet lines, and we are told of one filter that it transmits 72 per cent. of the light of the green line and ½ per cent. of the yellow, while by sacrificing 50 per cent. of the green light the yellow can be "completely absorbed." The list forms an excellent guide for those who use colour screens for any purpose.

AN address, delivered by Prof. Millikan at the recent meeting of the American Association for the Advancement of Science, is reproduced in *Science* for January 24. It deals with the atomic theories of energy, and shows that the only one which appears capable of explaining the whole of the facts of radiation, whether of light or of X-rays, is that advanced by Prof. Einstein, who, with Sir J. J. Thomson, supposes the radiation is concentrated in space along lines of force or Faraday lines, and not distributed uniformly over the wave surface, and further believes, with Prof. Planck, that along these lines the energy travels in atomic form and not as a continuous stream. The main objection to the general adoption of such a theory at the present time is its failure to explain the well-known facts of interference and diffraction of light.

THE third issue of the *Taschenbuch für Mathematiker und Physiker*, by Messrs. Teubner, contains a portrait of the late Prof. F. Kohlrausch, and a short account of his life. Five pages of the mathematical part are devoted to a report of the organisation and activities of the international commission on the teaching of mathematics. Other special articles deal with the theory of groups, with multiple valued functions and with analytical mechanics. The physical half has sections of the "quanten" theory, on physical chemistry and on crystallography. In both parts of the book vector methods are freely used, the quaternion being defined as the complex product of two vectors. The section on the "quanten" theory, by Prof. Sommerfeld, of Munich, gives a clear account of both the advantages and the difficulties of the theory. The pocket-book is well indexed, and contains a list of all the most important books on mathematics and physics which have appeared during the last two years.

IN the account, published in the issue of NATURE for April 11, 1912 (vol. lxxxix., p. 143), of the proceedings in connection with the one hundredth anniversary of the foundation of the Academy of Natural Sciences of Philadelphia, celebrated in March, 1912, it was stated that certain volumes would be published as a permanent record of the event. We have now received a copy of vol. xv. of the second series of the Journal of the academy, which has been published in a special form in commemoration of the hundredth anniversary celebration. It consists of two parts bound together, the first of which runs to 142 pages, and is concerned wholly with the proceedings of the centenary meeting. The second part contains twenty-two fully illustrated scientific memoirs, which together occupy 591 pages, and are illustrated by fifty-nine full-page plates, 11 in. by 14 in. Part i. consists chiefly of the addresses delivered by the mayor in welcoming the delegates, by the president, which took the form of a history of the academy, and by various speakers at the banquet, together with lists of delegates and selections from the congratulatory letters and cablegrams received from learned societies throughout the world. Some of the memoirs published in the second part of the volume were those read during the anniversary meetings. The frontispiece is a well-executed picture of the academy buildings, which, previous to the centenary meeting, were much enlarged and rendered fireproof with the assistance of the legislature of the State. The handsome volume forms a fitting memorial of an interesting series of meetings.

OUR ASTRONOMICAL COLUMN.

THE 100-IN. REFLECTOR AT MOUNT WILSON.—Some years ago the Mount Wilson Observatory ordered from France a 100-in. diameter mirror, the French foundry being the only one in the world which would undertake the casting of such a large mass of glass. The mirror, when delivered in California, was found not to be up to the standard of contract quality, and the French firm undertook to set about casting a new one. In the meantime, as an experiment, it was decided to figure the disc, and Prof. Ritchey worked away at it in the workshop at Pasadena. On the completion of his task, it appears from a note in *The Observatory* (March) that the tests have shown that the mirror is practically useless. It will be some time before the more perfect disc is procured, but it is hoped that the second attempt will be quite successful.

SOLAR RADIATION DURING THE ECLIPSE OF APRIL 17, 1912.—In the form of an extract from the *Comptes rendus de la Société Scientifique*, of Warsaw, we have received a paper in which Dr. W. Gorcynski describes the observations of the insolation made at Warsaw during the partial eclipse of the sun which occurred on April 17, 1912. The diminution of the solar radiation readings began about half an hour before the eclipse, and remained below the normal for the date for nearly the same time after. The maximum reduction of the solar radiation attained 89 per cent. at Warsaw, where 0·88 of the disc was covered at maximum phase, and the radiation curve agrees fairly well with the phase curve. Between noon and 4 p.m. each sq. cm. of surface received 110 great calories, at normal incidence, less than usual, and the drop in temperature, as recorded in the screen, was between 2° and 3° C.

BANTU STAR NAMES.—No. 12, vol. xii., of *Man* contains an interesting article by Miss A. Werner discussing the names by which the stars are described in Bantu by the tribes of Nyasaland. Miss Werner's general impression is that nearly, if not quite, all the peoples with whom she has come into contact have lost much star knowledge which they once possessed. The name for the Pleiades is always etymologically connected with agriculture, being derived from a root, *lima*, meaning "to cultivate," thus indicating that the Zulus, Swahilis, &c., have employed this asterism, as have so many other primitive races, as a substitute for the modern calendar. The "belt" stars of Orion seem always to be connected with hunting, and the name for Venus conveys generally the idea the planet is the moon's wife. The names applied to Jupiter also suggest a connection with hunting, a native explanation being that a hunting expedition should start on a night when Jupiter is overhead just before dawn. Several other of the names given are of special interest, and tend to show that the astronomical observations of primitive races are essentially utilitarian in character.

THE EXPLOSION OF WORLDS.—Some interesting speculations as to the possibility of such a world as the earth being shattered by the explosive energy of the now pent-up internal forces are published by Mr. Hudson Maxim in the February number of *The Fortnightly Review*. Among other things, he shows that the pressure of the earth's crust is so great that the most powerful explosive known, in any quantity, would fail to do more than shake it locally. Gravitational pressure is so enormous that were two solid steel balls, as large as the earth and as hard as the Harveyised surface of armour-plate, gently placed in contact they would flow together like water, and could have no variation from a true sphere greater than fifty miles high. By such arguments Mr. Maxim demonstrates the enormous strength and rigidity of the terrestrial sphere, and shows that it is immune from the effects of any shattering force less than the collision of the solar system with another celestial system.

THE DETROIT OBSERVATORY.—The first issue of the Publications of the Astronomical Observatory of the University of Michigan (vol. i., pp. 1–72) contains, *inter alia*, a most interesting account of the observatory and its work. The observatory also makes seismographic observations, and the records of the earthquakes recorded from August, 1909, to January, 1912, are given in the present publication.

THE INSTITUTION OF NAVAL ARCHITECTS.

THE meetings of the Institution of Naval Architects opened on Wednesday, March 12, in the rooms of the Royal Society of Arts. During the three days over which the meetings extended, fourteen papers were presented for discussion. The gold medal of the institution for 1912 was presented to Admiral Sir Reginald Custance, and premiums were awarded to Prof. Gümbel and to Mr. A. Cannon. The Marquis of Bristol, in his presidential address, referred to the loss the institution had sustained in the death of Sir Wm. White, and hoped that some memorial of a permanent character would be instituted by the various societies with which he had been connected, and that such memorial might take a form of practical service to the profession.

Mr. D. B. Morison gave some interesting data regarding the influence of air pumps on the military efficiency of turbine-driven warships. According to the latest cruiser practice, a vacuum of 28·5 in. is required at full power in sea water at 55° F. If, under conditions of maximum and constant generation of steam in the boilers, the vacuum falls from 28·5 to 27·5 in., then the loss in power is about 6 per cent. The minimum capacity of an air pump is determined by the quantity of air in the feed water as it enters the boiler, without provision for insidious leakage. From his experience with high-vacuum plants of the highest class, Mr. Morison does not believe that ideal air-tightness can be maintained under the severe conditions of war; hence the necessity for the provision of an air margin in the capacity of the air pumps. Various types of air pumps are discussed in the paper.

Sir Charles A. Parsons states in his paper on mechanical gearing that such gearing for reducing the speed between the turbine and the propeller is now well advanced beyond the experimental stage. This type of gearing is now in service on vessels representing a total of 26,000 h.p., and there are others under construction aggregating 120,000 h.p., including two installations of more than 20,000 h.p. each. The Channel steamers *Normannia* and *Hantonia* continue to show an economy, as compared with other turbine steamers of somewhat different design on the same service, of about 40 per cent. The *Normannia's* gearing, inspected recently, shows no signs of wear. Comparative coal consumption trials have been carried out on a cargo steamer, built for the Cairn Line, and fitted with turbines and mechanical gearing, and on a sister ship, the *Cairngowan*, with exactly similar boilers and propeller, but with triple-expansion engines. The coal was of the same quality, and measured in the same way on both ships, and the geared turbine ship has shown a saving of 15 per cent. in the coal consumption. So far, no limit in regard to the surface speed of the teeth in the gearing has been discerned, and there is no evidence of any limit to the power that can be transmitted by mechanical gearing with gear-wheels suitably designed. Careful investigations have been made of the causes producing noise in the gearing, and show that the noise is due to slight inaccuracies in the teeth; it should be noted that the noise is an engine-room noise only, and is not perceptible elsewhere. This has led to a method of cutting the gear-wheels, which greatly reduces the errors involved in reproducing the parent gear. Two rotating tables are used in the new machine; the wheel to be cut is fixed to the upper one, and is given a creep in advance of 1 per cent. in relation to the motion of the lower table; the lower table is driven by worm-gearing at 1 per cent. less speed than would be the case if a single table were employed; hence the wheel on which the teeth are being cut has a motion compounded of the motion of both tables, and equal to that required for the given number of teeth to be cut. This device has the effect of causing the errors in the teeth to lie in very oblique spirals around the wheel, and also reduces the errors themselves. In the actual machine, the errors are reduced to about one-fifth of the original magnitude.

Mr. W. Reavell contributed a paper on the use of compressed air for working auxiliaries in ships propelled by internal-combustion engines. It is of interest to note, in the operation of deck winches in cargo steamers, that although steam at a pressure of 90 lb. per sq. in. may be supplied, the actual pressure demanded by the winches in working did not exceed 16 lb. per sq. in. Earlier attempts to deal with such cargo-hoisting problems with high-pressure compressed air have been wasteful; modern installations in which air at low pressure is used for operating the winches have been successful and economical.

Baron A. Roenne contrasted the advantages and disadvantages of airships and aëroplanes, and gave a suggested design for an airship 853 ft. in length and 72 ft. 3 in. in diameter, having a displacement of 104 tons at 0° C., and 760 mm. of mercury. A speed of fifty-two miles per hour could be obtained with 2000 h.p., and it should be possible to carry a regular passenger service and to master the air on almost every day of the year.

In a paper on the longitudinal stability of skimmers and hydro-aëroplanes, Mr. J. E. Steele states that the most notable machine in the aëroplane show at Paris this year from the point of view of inherent longitudinal stability was one designed by M. Drzewiecki. The principle embodied in this design is that of difference in pressure intensity on the forward and the after curved planes, due to the different cross sections. On the involuntary rising of the front part of the machine, the increase in the angle of attack has quite a different effect on the fore to what it has on the rear plane. The pressure per sq. ft. on the front plane is but very gradually increased for changes of the angle of attack between the limits of 5° and 18°, whereas that on the after plane increases very rapidly with the angle at which the wind meets it. The result is an excess of lift aft, which restores the machine to its original position. The converse holds if the front of the machine is involuntarily depressed. The reduction in the angle of attack leaves the pressure on the front plane but slightly altered, but reduces quickly that on the rear plane, resulting in a drop of that part to the normal position.

Mr. G. S. Baker gives the first published account of systematic research work carried out at the William Froude tank at the National Physical Laboratory. The experiments had for their object the testing of the effect upon the resistance of the ship of varying the relative lengths of the entrance to run (*i.e.* those portions of the bow and stern respectively which are clear of the perfectly parallel midship body), maintaining the same general form, water-line, and principal dimensions. Five parent models have been chosen, and with each of these, four or five proportions of entrance and run have been tried. Another set of experiments has been carried out with the view of testing the effect upon model resistance of various possible terminations to the lines, both in fore and after body. The alterations tried have affected both the area curve and the water-line, and, in addition, the effect of the presence of the rudder has been tested in one case.

Mr. C. E. Inglis contributed a mathematical paper dealing with the stresses in a plate due to the presence of cracks and sharp corners. Exact results are obtained for the distribution of the stresses around a hole in a plate, the hole being elliptic in form. If the axes of the ellipse are equal, a circular hole is obtained; by making one axis very small the stresses due to the existence of a fine straight crack can be investigated. One of the several results obtained may be quoted. A strip of plate of indefinitely great width is pulled in the direction of its length, the tensile stress intensity being R. There is an elliptic hole in the plate having major and minor axes, $2a$ and $2b$ respectively, and arranged so that the major axis is at right angles to the pulls. At the edge of the hole situated at the extremity of the major axis, a tensile stress occurs having an intensity $R(1+2a/b)$. This stress decreases rapidly as we proceed along the section of the plate made by producing the major axis, and, at a short distance from the edge of the hole, attains the normal value R. It will be seen that the maximum value becomes very large if b is made small; if $a/b=1000$, the maximum tensile stress has a value of 2001 times the intensity of the mean stress. In this case the ellipse would appear as a fine straight crack, and a very small pull applied to the plate across the crack would set up a tension at the ends sufficient to start a tear in the material. The increase in the length due to the tear exaggerates the stress yet further, and the crack continues to spread in the manner characteristic of cracks.

A paper on the distribution of stress due to a rivet in a plate, by Prof. E. G. Coker and W. A. Scoble, is also of considerable interest. In a former paper measurements have been described of the differences of principal stresses at points in plates having notches and holes of various kinds. In the majority of the former cases, the stress distributions were such that the minor principal stresses vanished or were of little importance. In many practical problems, both principal stresses are of considerable magnitude, and it is then important to obtain each stress separately. The present paper describes a general method for determining both the sum and the difference of the principal stresses at a point in a plate, considered as averages taken over the normal at the point, and bounded by the two faces of the plate. The stress difference may be measured directly by mechanical or optical means, advantage being taken in the latter method of the fact that plates of glass, celluloid, and like transparent bodies, become temporarily doubly refractive when stressed, and that in polarised light there is, in consequence, a relative retardation, R, between the ordinary and extraordinary rays, which is proportional to the stress difference, and to the thickness T of the plate. If p_r and p_t are the magnitudes of the principal stresses, the law is given very approximately by $R=c(p_r-p_t)T$, where c is an optical constant. The sum of the principal stresses may be determined by taking advantage of the fact that a plate, when subjected to stresses in its own plane, alters in thickness. Thus, if both stresses p_r and p_t are pulls, there is a lateral contraction of amount $(p_r+p_t)T/mE$, where m is Poisson's ratio and E is Young's modulus. Hence by determining m and E and also by measuring the changes in thickness of a stressed plate, the sum of the principal stresses may be evaluated as an average throughout the thickness of the plate. Having obtained the sum and difference, it is a simple matter to state the values of p_r and p_t separately. A new form of instrument is described in the paper, specially devised for measuring small changes in thickness of a stressed plate. This instrument is partly optical, readings being obtained by means of a ray of light reflected from a mirror which is rotated partially by the strain to be measured. One millimetre on the scale is equivalent to two millionths of an inch change in the lateral dimensions of the specimen. A number of experimental determinations are given in the paper and show very concordant results.

COLLOIDS AND THEIR VISCOSITY.

SPECIAL interest attached to the meeting of the Faraday Society, held on Wednesday, March 12, in view of the distinguished foreign guests who took an active part in the proceedings. These included Prof. Pauli (Vienna), Dr. Wolfgang Ostwald (Leipzig), Prof. Victor Henri (Paris), Prof. Freundlich (Brunswick), and Prof. Nernst (Berlin).

The meeting took the form of a symposium upon colloids and their viscosity, and the afternoon session was opened by Dr. Wo. Ostwald, who, in an introductory address of a general character, showed the importance of viscosity measurements as a means of study of the colloidal state. In the course of his remarks, which were fully illustrated with examples, he laid special stress upon the need for kinetic, as opposed to static, methods for the investigation of heterogenous systems, and in this connection also emphasised the value of viscosity measurements. An illustration of this principle was immediately afforded by the communication of Profs. Freundlich and Ishizake on the rate of coagulation of $Al(OH)_3$-sols as measured by the viscosity change, the results of which were in complete accord with those of Paine upon copper oxide-solutions, using a totally different method. The following empirical formula proved to express the experimental results of coagulation by potassium salicylate with great exactness:—

$$dx/dz = 2Kz(1+bx)(1-x)^2,$$

where K is a constant depending on the concentration of the electrolyte, z represents time, and x the amount of precipitated particles, the latter taken as proportional to the increase in viscosity. From the equation in its more general form,

$$dx/dt = K_1 f(U)(1-x)^2,$$

Freundlich and Ishizake drew the following conclusions. The term $(1-x)^2$ suggests the coagulation process to be primarily a reaction of the "second order" in which the colloidal particles may be supposed to unite in pairs, the cause for which union is to be found in an asymmetry of their electric charges (expressed in the term $f(U)$) due to unequal degrees of electrolyte-adsorption. The degree of asymmetry was found to be proportional to the time z, to the number of precipitated particles, and to an exponent of c, the concentration of electrolyte thus:—$f(U) = \lambda c^q z(1+bx)$, where λ, q, and b are constants.

Prof. Pauli directed attention to the importance of viscosity measurements in the study of "emulsoid" colloids in a survey of the chief results obtained in his own school, showing what important generalisations as to the ionisation and degree of hydration of proteins in solution had been arrived at by this means. His experiments proved, for example, that at the iso-electric point, where, by definition, the ionisation of the protein is a minimum, a close correlation existed between that property and (1) osmotic pressure, optical rotation, viscosity, and imbibition of water, all of which reached their lowest value, and (2) precipitability by alcohol which was at its maximum. With increase in concentration of protein ions, caused by addition of either acid or alkali, a corresponding rise was found to occur in the value of the first set of properties and a fall in the precipitability.

The evening session was chiefly devoted to a discussion of the factors concerned in the viscosity of colloidal solutions and the interpretation to be placed upon the viscosity value. Mr. Emil Hatschek developed a mathematical theory of the viscosity of two-phase systems, showing that for "suspensoid" equally with "emulsoid" colloids, viscosity depended upon the volume-ratio of the two phases, and was independent of the size of the colloidal particles. In the case of the former, as shown also by Einstein and Bancelin, the viscosity increased in linear ratio with the volume of disperse phase, while in the case of "emulsoid" colloids the viscosity of the system was equal to $\frac{\sqrt[3]{A}}{\sqrt[3]{A}-1}$, where $A = \text{ratio}: \frac{\text{volume of system}}{\text{volume of disperse phase}}$, the viscosity of the continuous phase being taken as unity. Experimental support was adduced in both instances, and interesting confirmation also obtained for the above formula in the case of paraffin soap-solution emulsions, where viscosity had been determined by means of Couette's apparatus, and direct measurement could be made of the volumes of both phases. Prof. Henri gave a critical survey of the various direct and indirect methods available for volume-measurement of colloidal particles. He showed that, among the indirect methods, that of Perrin (based on the distribution with depth of colloidal particles after settling), and that of Rayleigh (by measurement of the intensity of light after lateral diffusion through colloidal solutions) were among the most trustworthy, since in the formulæ used for calculation of r, the radius of the colloidal particles, the term r was raised to the third and sixth power respectively. As a result of work with $Fe(OH)_3$-sols Prof. Henri, expressed the view that apart from the question of phase-ratio, or size of colloidal particles, the *arrangement* of the latter might have a very important influence upon the viscosity of the system.

An interesting discussion followed, in which, among others, Dr. Ramsden, Dr. S. B. Schryner, Dr. McBain, and Dr. C. J. Martin took part. In the absence of the chairman, Dr. R. T. Glazebrook, the chair was taken by Mr. Emil Hatschek.

ATMOSPHERIC HUMIDITY AND TEMPERATURE.

TWO papers on the psychrometer formula, reprinted from recent Proc. Roy. Soc., Victoria (vols. xxiv. and xxv.), discuss a modification, proposed by Dr. Ekholm, of the Stockholm Meteorological Office, to be made in Regnault's formula for the wet- and dry-bulb hygrometer, which would have important consequences if confirmed. The formula so modified would be $x = \eta f - AB(t-t')$, where x and f are respectively the actual vapour-pressure and the saturation vapour-pressure at the temperature t' of the wet bulb. A is the ordinary psychrometric constant, and η the coefficient, less than unity, inserted by Ekholm to allow for a supposed diminution of vapour-pressure at the surface of the wet bulb due to hygroscopic action of the material covering it. The first paper, by Dr. E. F. J. Love and Mr. G. Smeal (Government research scholar), dealt with temperatures near the freezing point, and the second, by Mr. Smeal, dealt with temperatures up to 31·4° C. The discussions appear to have proved that the suggested coefficient, being so nearly unity, is not wanted, especially if the covering be thin muslin and be kept clean. The factor, A=0·00072, derived from the observations and careful computations, varies slightly according to wind force. In the event of any modification of the simple formula being accepted it might be in this sense, but we suggest that it would be more to the point if one formula were selected from among those which already exist, and be recommended for general adoption.

A useful paper on the wet-bulb thermometer and tropical colonisation, by Prof. J. W. Gregory, F.R.S., is published in the Journal of the Scottish Meteorological Society (vol. xvi., No. xxix.). The author points out that the view that the tropics are injurious to health is prevalent, but the explanations why this is so are very unsatisfactory. Heat is mostly regarded as one of the principal factors of tropical maladies, but it is now recognised that no locality with a *dry* climate has a temperature so high as to be injurious to health; in fact, the hottest districts in a country are often the healthiest. Healthiness of tropical localities does not depend upon diurnal or annual range of temperature, and moisture is not necessarily injurious; the latter is better for some constitutions, but heat and moisture combined may be very harmful. Experiments appear to indicate that "the industrial development of any locality where the wet-bulb temperature commonly exceeds 80° will be almost, and if it exceed 88°, quite impossible." But statistics supplied to the author by the Meteorological Office show that such high wet-bulb temperatures do occur in well-populated tropical localities. The author laments that the distribution of such temperatures is not well known, and refers to the collection of observations in Australia by Prof. W. A. Osborne, of Melbourne. The annual summary of the Australian Monthly Weather Report for 1910 (received by us in July, 1912) contains monthly wet-bulb isotherms from 9h. a.m. observations, with means of 80° in the northwest in December–February inclusive.

RECENT ADVANCES IN SCIENTIFIC STEEL METALLURGY.[1]

IT has already been pointed out that the year 1870 marked the commencement of the tungsten era, and 1880 that of the tungsten-chrome era. But the years 1899 to 1902 inaugurated what is destined to be the most remarkable epoch of the three, namely the vanadium era. During these years was carried out in the experimental steel works of Sheffield University a series of researches on the influence of the comparatively rare metal vanadium on plain carbon steel and on alloy steels. At that time (1899) vanadium was 60*s.* per lb. In 1912, owing to the large demand, the cost had fallen to 10*s.* per lb.

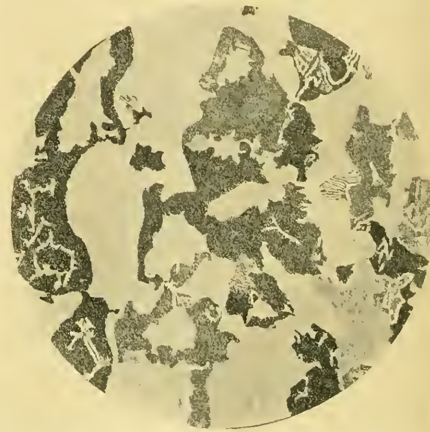
The first report, having reference mainly to cutting steels, was issued in June, 1900, and the second and third reports respectively in January and June, 1902. The results are briefly summarised in the two next paragraphs.

June 28, 1900.

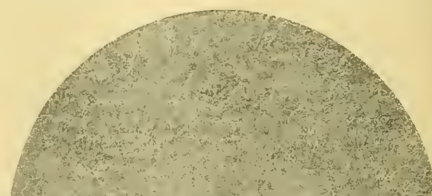
"The results of this preliminary investigation have profoundly impressed upon my mind the future before vanadium as a steel-making element, and even at this early stage of my knowledge of its effect, I venture to say that its action resembles that of tungsten, but that it is from ten to twenty times as powerful as the latter element."

January 14, 1902.

"It is already evident that as a steel-making element vanadium will place in the hands of metallurgists and



(*a*) Carbon, 0·60 per cent. Vanadium, 0·71 per cent. Pale ground mass of slightly vanadiferous ferrite. Dark areas, troostitic vanadium pearlite. Less dark areas, sorbitic vanadium pearlite. White cell walls and masses, "B" iron cementite, resulting from thermal decomposition of laminated iron pearlite, a few areas of which still remain undecomposed.



(*b*) Carbon, 0·93 per cent. Vanadium 5·84 per cent. Ground mass of sorbitic vanadium pearlite, overlaid with a broken and irregular mesh-work of vanadiferous ferrite.

FIG. 6.—Magnified 450 diameters.

engineers a very powerful weapon, because it is now demonstrated beyond doubt that the addition of a few tenths per cent. of vanadium raises the elastic limit of mild structural steel at least 50 per cent., without seriously impairing its ductility or presenting any difficulty in the hot or cold working of the steel."

[1] Discourse delivered before the Royal Institution on Friday, January 24, by Prof. J. O. Arnold, F.R.S. Continued from p. 49.

Some of the results upon which these paragraphs were founded are tabulated below. Perhaps the most remarkable results in this series are:—

(1) A plain carbon steel containing about 1 per cent. of carbon has a yield point of 35 tons per square inch, a maximum stress of 60 tons per square inch, an elongation of 10 per cent. on 2 inches, and a reduction of area of 10 per cent. The addition to such steel of about 0·6 per cent. of vanadium raised the yield point from 35 to 65 tons, the maximum stress from 60 to 86 tons per square inch, still leaving an elong[illegible] 7 and a reduction of area of 8 per cent.

(2) A steel containing 0·25 per cent. of carbon and 3·3 per cent. of nickel registered a yield point of 33 tons, a maximum stress of 42 tons per square inch, an elongation of 26 per cent. on 2 inches, and a reduction of area of 53 per cent.

A practically identical steel, but containing in addition about 0·25 per cent of vanadium, recorded a yield point of 50 against 33 tons, a maximum stress of 68 against 42 tons per square inch. The elongation was 17 per cent. on 2 inches, and the reduction of area 36 per cent.

(3) A steel containing 0·25 per cent. of carbon and about 1 per cent. of chromium registered a yield point of 27 tons, and a maximum stress of 41 tons per square inch, together with an elongation of 36 per cent. on 2 inches, and a reduction of area of 55 per cent.

The addition of 0·25 per cent. of vanadium raised the yield point from 27 to 40, and the maximum stress from 41 to 55 tons per square inch. The elongation was lowered from 36 to 26, and the reduction of area from 55 to 53 per cent.

Thus vanadium differs from tungsten in having an almost magically beneficial effect, not only on cutting, but also on structural steels. In connection with vanadium steels it is an interesting fact that the series of copyrighted and published reports issued from Sheffield University during the years 1900 to 1902 were unconscious plagiarisms of a series of American patents issued during the years 1904 to 1908. This seems to constitute a remarkable problem in psychology.

A study of what may be called the pure science of vanadium steels made by the lecturer and Prof. A. A. Read, of the University of Wales, has yielded results of profound theoretical and probably practical importance. It was shown that vanadium does not seem to form a double carbide with iron. It gradually wrests the carbon from the carbide of iron until when about 5 per cent. of vanadium is present Fe_3C cannot exist, and only a vanadium carbide, V_4C_3, containing 15 per cent. of carbon is present, and this constituent is constant, at any rate in tool steels containing up to 14 per cent. of vanadium. The micrographic analysis of these alloys, as shown in Fig. 6 (*a*) and (*b*), has resulted in the discovery of three new constituents, viz. vanadium pearlite, vanadium hardenite, and vanadium cementite. Vanadium hardenite seems to have a hardness of 8 (topaz) as compared with the hardness 7 (quartz) of iron hardenite.

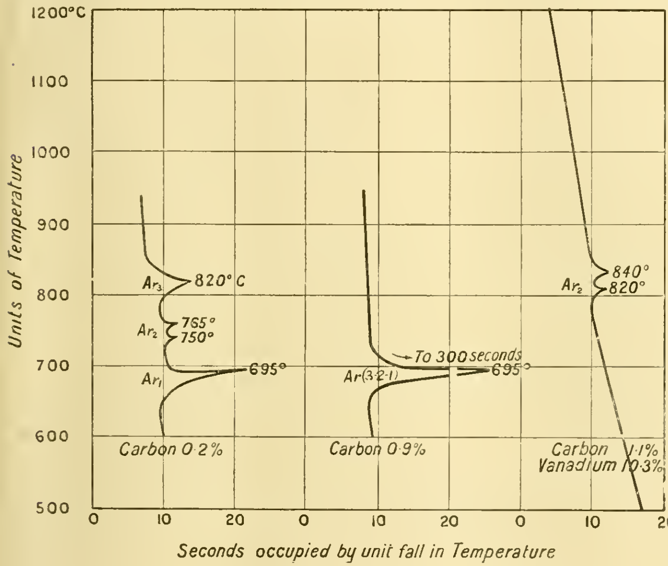


FIG. 7.

The recalescence results obtained are of great practical, as well as theoretical, interest. They strongly suggest the explanation of the curious thermo-mechanical behaviour of high-speed steels, and incidentally they appear provisionally to prove that the hardening is not due to allotropic change, but to the carbon change only. Fig. 7 shows (1) the inverse rate recalescence curve of a 0·2 per cent. plain carbon steel, which exhibits all Osmond's critical points, viz., Ar_3, Ar_2 (with a double peak) and Ar_1, the carbon change point; (2) the recalescence of a saturated steel containing 0·89 per cent. of carbon, in which all three points are merged into one very large evolution of heat at 695° C.; (3) the recalescence curve of a steel containing 1·1 per cent. of carbon, and 10·3 per cent. of vanadium. This curve was registered from 1210° to 505° C. It presents only the double-peaked point Ar_2. When the steel is quenched all along the above range it still remains quite soft to the file. To harden it it is necessary before quenching in water to heat the alloy above the A_1 or carbon change point, which takes place at a white heat, near 1400° C. The steel is then very hard.

Fig. 8 shows the transformation on heating up to a white heat (*a*) of annealed vanadium cementite into vanadium pearlite, (*b*) or sorbitic vanadium pearlite into amorphous and topaz-hard vanadium hardenite.

The advance in concrete cutting efficiency of turning tools from 1740 to 1912 was then dealt with. It should be noted that the best steel of this kind made in Sheffield in 1740 would be absolutely incapable of cutting at all under conditions under which the best modern high-speed steel would remove 700 cubic inches of metal before breaking down.

The advantages of this enormous increase in cutting power are manifold, and an obvious example is the relative rapidity with which huge naval guns may now be turned out.

In January, 1909, I had the honour of suggesting to a Royal Institution audience the coming of a new British steel which would have a cutting power four times as great as the best steel then on the market. The skilful application of vanadium by Sheffield steelmakers has practically fulfilled that forecast, and the world-wide sensation and publicity created by the announcement has left Great Britain supreme in this very important branch of scientific steel metallurgy. An aspect of iron and steel metallurgy already demanding attention is the diminishing quantity of the

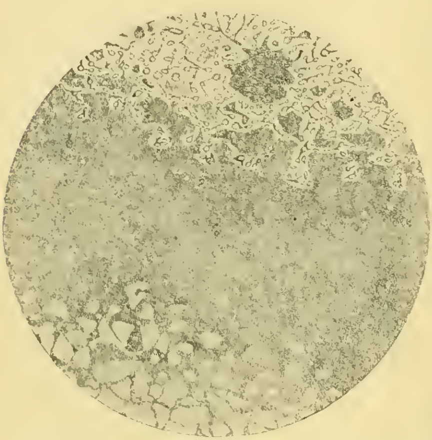


FIG. 8.—Carbon, 1·10 per cent. Vanadium, 13·45 per cent. Transformation stages of vanadium cementite and vanadiferous ferrite into vanadium hardenite. Upper area, mainly vanadiferous ferrite with vanadium cementite nodules, together with a little sorbitic vanadium pearlite. Middle area, ground mass of unsaturated vanadium pearlite, overlaid with undissolved nodules of vanadium cementite. Lower area, mainly structureless vanadium hardenite cells formed from a series of centres and surrounded by walls of the structure described for middle area Hardening temperature, near 1400° C. Magnified 450 diameters.

world's iron ore supply. To a great extent the latter could be strongly reinforced from the huge deposits of iron sands now lying useless if a simple, economical and direct process of reduction could be devised. That metallurgical science and art will do this eventually seems certain, and I hold an opinion, founded on practical data, that the solution of this hitherto baffling problem is nearer than most metallurgists suppose.

In conclusion, it may be pointed out that the skeleton history of early Sheffield steel metallurgy sketched in this discourse is in some important points in conflict with the somewhat disparaging historical outline written by Lord Macaulay, but in this particular connection there seems to be a modicum of truth in the answer of the schoolboy who, when asked to mention his favourite work of fiction, unhesitatingly replied, "Macaulay's History of England."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DURHAM—ARMSTONG COLLEGE.—The foundation-stone of the new building for the department of agriculture is to be laid on Saturday, April 5. Mr. C. Cochrane has promised the sum of 2,500*l.* towards the equipment of the department, and a Diesel engine has been offered to the college by Mr. G. E. Henderson. The appointment has been approved of Mr. G. D. H. Cole as deputy professor of philosophy, in the absence of Prof. Hoernlé, who is to deliver a course of lectures at Harvard University between October, 1913, and January, 1914.

THE Senate of the University of Dublin has approved the conferment of the honorary degree of doctor of science upon Prof. A. C. Seward, F.R.S., and Prof. the Hon. R. J. Strutt, F.R.S.

BY the will of Sir Alfred Jones, 227,100*l.* is left to charitable and educational institutions, and the scheme for carrying out the objects of the will has just been sanctioned by Vice-Chancellor Dudley Stewart-Smith. By the provisions of the will the Liverpool School of Tropical Medicine will receive 40,000*l.*, and a further 40,000*l.* when the annuities payable out of the estate cease. The 40,000*l.* now given is to form a fund to be called the "Sir Alfred Lewis Jones Bequest," and is to be devoted (*a*) to defraying the cost of a new wing or ward to the Liverpool Royal Infirmary for the reception of persons suffering from tropical diseases, to be called the "Sir Alfred Lewis Jones Tropical Ward"; (*b*) to the erection of new premises in Liverpool for the study of tropical medicine, to be permanently associated with the name of the testator; (*c*) to the erection and equipment of a laboratory in Sierra Leone, to be called the "Sir Alfred Lewis Jones Tropical Laboratory"; (*d*) the residue of the gift is to be used as a permanent endowment. 20,000*l.* is left for the promotion of technical education in British West Africa, and 1000*l.* to Liverpool University.

BY the will of Mr. John Fritz, the iron master, says *Science*, his residuary estate, amounting to about 30,000*l.*, is given to Lehigh University primarily as an endowment fund for the maintenance of the Fritz Engineering and Testing Laboratory. It is also announced that Mr. Charles L. Taylor, of Pittsburg, has given Lehigh University a gift for a large gymnasium and a stadium. From the same source we learn that by the will of the late Mr. C. C. Weld, of Newport, R. I., the residuary estate, valued at nearly 800,000*l.*, is, in case his daughter dies without issue, to be divided between the Massachusetts General Hospital and the Massachusetts Institute of Technology.

AT the opening of a new technical college and secondary school at Workington last week, Sir John Randles said he desired to commemorate the occasion by a gift of 1000*l.*, to provide a travel scholarship for a student of the college. The gift will yield some 50*l.* or 60*l.* each year to a student to assist him to become proficient in the metallurgy of iron and steel, which is associated with the local industry. The money is to be used by the student, within three years of its being awarded, in visiting some Colonial or foreign metallurgical centre, and may be recreative as well as useful. In this way Sir John Randles hopes some of the pleasure he has enjoyed in life by travel will be secured year by year to a Cumberland youth.

THE President of the Board of Education, Mr. J. A. Pease, spoke at a meeting of the National Union of Teachers at Sheffield on March 15, and referred to the intentions of the Government with regard to education. He said the Government are not pledging themselves to carry an Education Bill this session; their proposals are to be placed before the House of Commons with a view to their discussion. In the next session of Parliament it is hoped to pass the proposals—with such alteration as may have been thought expedient—into law. It is proposed to add considerably to the powers that local authorities already possess in educational affairs. The Government wish to induce everybody to cooperate so as to make the boy and girl better fitted to render the best possible service to the State. They wish to bring the best brains to the top, and to provide for those not included in that category an education from which they will get most advantage in connection with the factories, or the workshops, or whatever vocation they adopt in after life. Account must be taken of the conditions of youth from the cradle up to the universities, and all the nation's educational energies must be marshalled on a strategic plan. The Government's scheme is not going to be limited to an attempt to solve what Mr. Pease believes to be an insoluble denominational problem. The general principle of the Government's scheme is to secure that the best brains of the whole community should get to the top, and to provide a general diffusion of knowledge, so that we shall possess an educated democracy.

Lord Haldane is to speak on the educational proposals of the Government at a joint meeting of teachers in secondary and technical schools, to be held at the University of London, South Kensington, on Saturday, March 29. The meeting is organised by the Association of Assistant Masters in Secondary Schools. The headmaster of Eton will preside, supported by Mr. Arthur Acland, and the following resolutions will be submitted:—"That this meeting welcomes the announcement that the Government proposes to deal in the near future with the question of education; hopes that the State will leave to the schools all reasonable freedom in such matters as time-table, curriculum, and careful educational experiments; and, with the object of attracting into the schools a sufficient supply of able and efficient teachers, urges that the increase of salaries and the provision of an adequate pension scheme should be a first charge upon any further grants for secondary and technical education." "That this meeting is of opinion that no pension scheme for secondary and technical teachers in England and Wales can be considered adequate which does not provide benefits approximately equal to those now secured to Scottish teachers."

The Institution of Mechanical Engineers has now established graduateship and associate membership examinations, and has published the rules which will govern the examinations. The institution has in this way decided to cooperate with other engineering societies in the endeavour to define and raise the status of the engineer. The examinations will be held in London twice annually, in April and October. The "graduate" is defined as a person, not under eighteen years of age, who has passed the graduateship examination or reached some exempting standard, and has satisfied the council that he has received or is receiving regular training as a mechanical engineer with the necessary practical and scientific experience. No person is to be elected a graduate after twenty-five years of age. The institution's examination for graduates covers English, elementary mathematics, and scientific knowledge, and matriculation and similar certificates exempt the candidate from the test. The associate membership examination is ordinarily for candidates of from twenty-five to thirty years of age, and covers general, scientific, and technical knowledge. General knowledge includes an essay on some subject in literature, science, technology, or economics and workshop organisation; scientific knowledge is tested by papers in applied mathematics, physics, and chemistry; and a choice of two technical subjects must be made from seven specified. Several recognised examinations exempt candidates from the institution's associate membership examination, and for candidates over thirty years of age special arrangements are made.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 13.—Sir Alfred Kempe, vice-president and treasurer, in the chair.—A. **Mallock**: A simple method of finding the approximate period of stable systems.—Prof. J. S. **Townsend** and H. T. **Tizard**: The motion of electrons in gases.—Prof. T. R. **Lyle**: The self-inductance of circular coils of rectangular section.—Dr. A. E. H. **Tutton**: Ammonium ferrous sulphate and its alkali-metal isomorphs. The author has added this salt to the thirty-six salts of the series

$$R_2M\left\{\begin{matrix} S \\ SeO_4 \\ Cr \end{matrix}\right\}_2 \cdot 6H_2O$$

which he has previously investigated in a detailed manner, both morphologically and optically.—H. **Thirkill**: The re-combination of the ions produced by Röntgen rays in gases and vapours. Measurements, under widely varying conditions, of the coefficient of re-combination of the ions produced by Röntgen rays in gases and vapours have yielded the following results:—(1) Re-combination seems to take place according to the simple law $dn_1/dt = dn_2/dt = -\alpha n_1 n_2$. (2) For a certain range of pressure, the coefficient of re-combination is proportional to the pressure.—Dr. W. **Wahl**: Optical investigation of solidified gases. III., The crystal-properties of chlorine and bromine. Crystallised chlorine and crystallised bromine are rhombic. Bromine is strongly pleochroic; chlorine less so. The absorption diminishes strongly when the temperature is lowered. The existence of a complete analogy in the crystalline characters of chlorine, bromine, and iodine has been established.—F. B. **Pidduck**: The abnormal kinetic energy of an ion in a gas. The abnormal rate of diffusion of negative ions in dry air, investigated by Townsend, would be explained if the negative ions had a velocity of agitation in excess of that of an equal number of molecules of the gas. The present paper investigates this from the point of view of the kinetic theory of gases.

Geological Society, February 26.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—Dr. C. A. **Matley**: The geology of Bardsey Island (Carnarvonshire), with an appendix on the petrography by Dr. J. S. **Flett**. Bardsey, an island a mile and three-quarters long, lies off the promontory of the Lleyn (western Carnavonshire), and forms the isolated extremity of the strip of pre-Cambrian rocks that borders the western coast of the Lleyn from Nevin south-westwards. The rocks are principally gritty schistose slates, with many thin and some thick bands of grit, quartzite, and limestone; and they contain an horizon of variolitic lava and tufaceous shale, which indicates that a volcanic episode took place during their formation. Sills of albite-diabase also occur, as well as one or more sills of a crushed granite.—E. B. **Bailey**: The Loch Awe syncline (Argyllshire). This syncline is a comparatively shallow trough, with well-marked fan-structure due to small-scale isoclinal folding, in which the limbs of the folds are vertical along the axial belt of the syncline, and inclined outwards on either side.

Physical Society, February 28.—Prof. A. Schuster, F.R.S., president, in the chair.—Prof. C. G. **Barkla** and G. H. **Martyn**: The authors have made a preliminary investigation of the Röntgen radiation proceeding from a crystal of rock salt (which is of the simple cubical form) when a pencil of Röntgen radiation is incident in a direction nearly grazing one of the three sets of mutually perpendicular cleavage planes. Reflection of X-rays by the cleavage planes. —Using a very narrow pencil of radiation, it was seen that the principal secondary pencil was one obeying the laws of reflections from the cleavage planes. A pencil diverging in all directions from a point source produced a corresponding reflected pencil of radiation converging to a line focus after reflection from a set of parallel cleavage planes. The quality of the radiation forming the secondary pencils was shown both by the photographic and by the ionisation method to be, not the fluorescent X-radiation, but of the kind previously described as scattered X-radiation. It was approximately of the same penetrating power as the primary radiation, and was approximately homogeneous, having traversed 5 mm. of rock salt in the case investigated. Interference fringe systems.—A diverging pencil of radiation was directed on to a crystal so that various portions were incident on the cleavage planes at different angles. A photographic plate showed the relative intensity of the corresponding reflected radiations. It was seen that the intensity of the reflected pencil varied periodically with varying angle of incidence, the maximum being separated by intervals corresponding to approximately equal increments in the value of $\cos\theta$, where θ was the angle of incidence on the reflecting planes. Such a series of maxima may be explained by interference of the pencils reflected from equal spaced parallel planes, the maxima being spectra of various orders. The wave-length, calculated on the assumption that these are planes passing through corresponding portions of molecules in the planes of cleavage, and that a molecule is simply NaCl, is found to be $0{\cdot}6 \times 10^{-9}$ cm. If the molecule be more complex, the calculated wave-length would be greater. This value thus agrees remarkably well with the value (between 1 and 2×10^{-9} cm.) calculated from the velocity of ejection of electrons by this X-radiation, taking this to behave as ultra-violet light of short wave-length. There can be little doubt that the fringe systems are interference fringe systems. That the smaller system is a series of spectra of different orders and the other an interference band system seems probable; this theory certainly explains the results observed up to the time of writing.—Prof. E. **Wilson**: Alternating-current magnets. It follows from the well-known law of pull of an electromagnet that if the magnetic field alternates between positive and negative values the pull is undirectional and intermittent. Unless means are provided to reduce the consequent chattering and vibration, the magnet is rendered useless. In the present experiments a phase-splitting device has been adopted, and consists in surrounding a portion of the pole-piece of the magnet with a short-circuited coil. The portion of the pole-piece so surrounded is sometimes said to be "shaded," and the coil referred to as a "shading" coil. The effect of this coil is to alter, not only the relative amplitudes, but the phase of the magnetic fields passing through the shaded and unshaded portions of the pole-face.

Linnean Society, March 6.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Geoffrey **Smith**: The development and inheritance of sexual characters. (Discussion.)

Zoological Society, March 4.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—Dr. F. E. **Beddard**: The anatomy and systematic arrangement of the Cestoidea. A new genus of tapeworms, of the family Ichthyotæniidæ, from the crossed viper (*Lachesis alternans*) was described.—Dr. W. A. **Cunnington**: The Branchiura collected by the third Tanganyika expedition in 1904–5. The collection contained more than 300 specimens, and proved that in the case of this group of animals also, Lake Tanganyika exhibits a number of endemic forms. While two species of Argulidæ are known to be widely distributed in the lakes of Africa, they are associated in Nyasa with a single form peculiar to that lake, but in Tanganyika with no less than seven new types. Tanganyika is thus shown to possess not only a considerable number of characteristic species, but a much richer Branchiuran fauna than the other great African lakes. The paper was illustrated by lantern-slides made from photomicrographs of the new species.—W. **Schaus**: Descriptions of a large number of new species of Rhopalocera from Costa Rica. More than 100 species had been collected, and of these fifty-four were found to be new.—Dr. A. **Willey**: Notes on plankton collected across the mouth of the St. Croix River, New Brunswick, in July and August, 1912.

Mineralogical Society, March 11.—Prof. H. L. Bowman, vice-president, in the chair.—W. Campbell **Smith**: The mineral collection of Thomas Pennant (1726–98). The collection, which has recently been presented to the British Museum by the Earl of Denbigh, is accompanied by three volumes of manuscript catalogue written in 1757. The classification used in them is based, with some modifications, on Woodward's "Natural History of the Fossils of England," published in 1729. Special mention is made of specimens presented by Borlase, Pontoppidan, and da Costa, and the minerals from Flintshire were treated in some detail. Several specimens were described by Pennant in "A Tour in Wales."—Arthur **Russell**: The minerals and mineral localities of Montgomeryshire. Of the species described the more remarkable are aurichalcite, from Llanymynech Hill Mine, Llanymynech; harmotome in double twins, associated with barytes and witherite, from Cwm-orog Mine, Llangynog; hydrozincite, which forms a remarkable recent deposit on the sides of a level in the Van Mine, Llanidloes; pyromorphite from Aberdeunant Mine, Llanidloes, and Llanerch-yr-aur Mine, Llanbrynmair; witherite, from Cwm-orog Mine, Llangynog, Gorn Mine, Pen-y-gaer Mine, and Pen-y-clyn Mine, Llanidloes, the crystals from the last being noteworthy on account of the almost entire suppression of the alternate faces of the pseudo-hexagonal prisms and pyramids.—Dr. G. F. Herbert **Smith**: A new stereographic protractor. The novelty consists of a curved ruler, made up of a combination of springs, which sensibly retains a circular curvature within the limits for which it is required. At the centre of the arc it is clamped to an arm, movable in a groove and carrying a scale, from which the azimuth of the corresponding great circle may be read off. The other edge of the protractor carries the usual tangent scales, from which the position of the compass to draw any circle up to the one corresponding to the great circle making an azimuth of 50° with the equatorial plane may be determined. The scales are based upon a radius of 10 cm.—L. J. **Spencer**: A (sixth) list of new mineral names.

Royal Meteorological Society, March 12.—Mr. C. J. P. Cave, president, in the chair.—R. G. K. **Lempfert**: Weather forecasts: past and present. For the preparation of forecasts, information is now received at the Meteorological Office each day by telegraph from thirty British stations, and from forty on the continent of Europe and the islands of the North Atlantic. Information from thirty stations is, however, quite inadequate for checking the accuracy of the forecasts. For this purpose results from more than 130 stations are used. The forecasts are checked separately for wind and weather, the term weather being considered in regard to (1) temperature; (2) precipitation; (3) cloudiness or the reverse; (4) fog. The extension of the period covered by the forecasts for "further outlook" was described, and the application of this to the notification of probable spells of fine weather which the Meteorological Office now issues to farmers during the summer.

Mathematical Society, March 13.—Prof. Love, president, in the chair.—H. M. **Macdonald**: The diffraction of light by an opaque prism.—S. **Lees**: The natural radiation from transparent media.—L. J. **Mordell**: Indeterminate equations of the third and fourth degrees.—A. **Cunningham**: Mersenne's numbers.—J. **Proudman**: (1) A two-dimensional potential problem with applications to hydrodynamics and elasticity; (2) tidal motion in rotating sheets of water.

Royal Astronomical Society, March 14.—Major E. H. Hills, C.M.G., F.R.S., president, in the chair.—H. F. **Newall** and F. J. M. **Stratton**: Enhanced lines in the early spectrum of Nova Geminorum No. 2. The elements most strongly represented by these lines are titanium and iron; a number of other elements were indicated with less certainty. Two well-known bands frequently ascribed to helium were considered by the authors to be enhanced lines of iron.—F. W. **Dyson**: The distribution in space of the stars of Carrington's circumpolar catalogue. This catalogue contains practically all the stars of the Bonn Durchmusterung within 9° of the north pole. The paper dealt at length with the proper motions of the stars, the proper motions being based on those determined in connection with the Greenwich astrographic work.—A. S. **Eddington**: The distribution in space of the bright stars. The stars considered were those brighter than 5·8 magnitude. Stars of the spectral types A and K were separately dealt with, and in each case results were obtained for two regions, one typical of high galactic latitudes and one of low.—Major **Hills** and F. C. H. **Carpenter**: Results of observations with the Durham almucantar during 1912. The results on the whole were not very encouraging, as there are two errors which are peculiar to all floating instruments—the temperature gradient and the unsteadiness of the telescope. These may be reduced, but it does not seem possible to eliminate them; the almucantar thus seems an inferior instrument to the transit circle.—R. S. **Capon**: Note on the possibility of refraction in the solar atmosphere (papers of the International Union for Solar Research, No. 8).

CAMBRIDGE.

Philosophical Society, February 10.—Dr. Shipley, president, in the chair.—G. R. **Mines**: Note on the respiratory movements of *Torpedo ocellata*. A method for recording the frequency and amplitude of rhythmic movements over prolonged periods of time is described. The respiratory movements of elasmobranch fishes are known to be of two kinds, the ordinary breathing movements interrupted by occasional "spouting movements." The spouting movements can be produced with ease by the slightest irritation of the inside of the pharynx, as by the introduction of foreign particles with the water. It has therefore been supposed that whenever the spouting movements are observed they indicate the entry of some foreign object with the inspired water. Experiments made with the apparatus referred to above show that the spouting movements have a tendency to recur at rhythmic intervals. The period of this rhythm is often as long as two to five minutes, but sometimes it is shorter. The modifications it undergoes in response to changes in the environment suggest that the nerve cells controlling the movements have themselves a tendency to discharge rhythmically.—F. A. **Potts**: The swarming of Odontosyllis. The appearance of great numbers of sexually mature individuals of *Odontosyllis phosphorea* was observed on the surface of the sea near Nanaimo, Vancouver Island, in the years 1911 and 1912, during four days in the latter part of August. The swarming begins before sunset, lasts nearly an hour, and is almost over before it is quite dark. A comparison was drawn with *O. enopla* from the Bermudas, described by Galloway and Welch, in which the time of swarming is a little later and phosphorescence is so greatly developed as to be used as a method of sexual recognition. Only in the case of the insects elsewhere has luminosity been proved to possess an adaptive significance.—S. R. **Price**: Observations on *Polyporus squamosus*. *Polyporus squamosus*, Huds., is a well-known timber-destroying fungus, frequent on many species of our trees. The artificial culture of the fungus on sterilised wood blocks was described for the first time.—R. H. **Rastall**: Note on the composition of some Pleistocene sands near Newmarket.

MANCHESTER.

Literary and Philosophical Society, February 18.—Prof. F. E. Weiss, president, in the chair. Prof. G. Elliot **Smith**: The Sussex skull and its brain-cast. Plaster copies were shown of the fragments of the Sussex skull and the cast made from them to represent the formation of the brain. An account of our present knowledge of ancient man was given in order to illustrate the importance of the new information supplied by the Sussex remains.

March 4.—Prof. F. E. Weiss, president, in the chair.—A. D. **Hall**: The plant and the soil. The plant takes but a very small portion of its substance out of the soil, but that little is indispensable. Growth especially depends upon the supply of nitrogen, phosphoric acid, and potash, and the function of a manure is to supply the deficiencies of an ordinary soil in one or more of these substances. These substances having to be in solution before entering the plant, one had to conceive of the water which is always present in the soil in a thin film coating the soil particles as a nutrient solution containing more or less of the materials determining the plant's rate of growth. Compounds of phosphoric acid and potash present in the soil possess but a very slight solubility, and the soil solution would become saturated to its utmost capacity even though the soil contained much less phosphoric acid and potash than are ever found in cultivated land. The acceptance of this view prevents the difference between good and bad soil being attributed to any difference in the amount of phosphoric acid and potash in the soil; moreover, additions of these substances could not directly stimulate the nutrition of the plant. This hypothesis had then to face the well-known fact that the yield of crops on particular soils could be greatly increased by certain manures, namely phosphates. American investigators propounding this theory suggest that the manure acts by precipitating and putting out of action certain injurious substances excreted by the roots of the plants. The value of proper aeration of roots was demonstrated, and results of wheat- and barley-growing experiments given. The theory of the indifference of the plant to the amount of nutrients in the soil was found to be untenable.

EDINBURGH.

Royal Society, February 17.—Dr. Horne, F.R.S., vice-president, in the chair.—Helen **Pixell**: Polychæta of the families Serpulidæ and Sabellidæ, collected by the Scottish National Antarctic Expedition. Eight genera were represented in the collection, including four new species, one in Apomatus, two in Spirorbis, and one in Potamus.—Dr. J. R. **Milne** and H. **Levy**: The recording of fluctuating flow: its difficulties and errors. Owing to the inertia of its moving parts, any instrument employed to record either "instantaneous values" or the "time integral of a fluctuating quantity" is liable to err. The extent of this error is in many cases unknown, *e.g.* in the case of a Robinson cup anemometer; and the present paper describes some experiments made with an analogous instrument to elucidate the matter. From the results obtained it appears that fluctuation in the flow causes the instrument to read too high.

March 3.—Prof. Bower, F.R.S., vice-president, in the chair.—Dr. R. A. **Houstoun**, A. H. **Gray**, and C. **Cochrane**: The absorption of light by inorganic salts (three concluding papers of a series). No. IX. dealt with salts of copper, cobalt, and nickel dissolved on alcohol and acetone, and described a successful attempt to apply the mathematics of mass action to the change of colour in an alcoholic solution of cobalt bromide when water was added. No. X. was occupied more particularly with the bearing of new methods on the old controversy of the colour of the ions, and it was shown conclusively that the colour changes of the cobalt, nickel, and copper salts have nothing whatever to do with ionisation. In No. XI. Dr. Houstoun discussed the theoretical aspect of the results gained and the present state of research in the field.—Dr. G. A. **Carse**, G. **Shearer**, and H. **Jameson**: Note on a comparison of records of atmospheric potential at two stations in Edinburgh. The two stations were the Physical Laboratory of the University and the Royal Observatory, Blackford Hill. A large number of records were compared, and the curves for the two stations showed in general good agreement, the agreement being best in those which indicated a disturbed state of the atmosphere. This is interesting when it is considered that the University is in the centre of the town and the observatory in the clearer air of the outskirts, nearly two miles distant.

DUBLIN.

Royal Dublin Society, February 25.—Prof. J. Wilson in the chair.—Dr. G. H. **Pethybridge**: The rotting of potato tubers by a new species of Phytophthora having a method of sexual reproduction hitherto undescribed. A new form of rot in potato tubers is described, in which the cut surface of affected tubers when exposed to air turn at first pink and afterwards nearly black. The causative organism is a new species of Phytophthora, to which the name *P. erythroseptica* is given. Sexual organs are produced when the fungus is grown artificially as a saprophyte, and probably also in nature. At an early stage in its development the young oogonium penetrates the antheridium at or near the base of the latter, grows up through it, bursts out at the summit, where it swells to form the oogonium proper, in which the oosphere and oospore develop. Fertilisation, if it takes place at all, probably occurs while the oogonial incept is within the antheridium, and hence before the formation of the oosphere. The sexual organs of *P. Phaseoli*, *P. infestans*, and probably *P. omnivora*, var. *Arecae*, are developed in a similar manner, but those of *P. cactorum*, *P. fagi*, *P. Syringae*, and probably others, follow the usual course, where the antheridium penetrates the oogonium laterally. Species which follow this latter method are removed from the genus Phytophthora, and are placed in a new one, to which the name Nozemia is given.—Dr. G. H. **Pethybridge** and P. A. **Murphy**: Pure cultures of *P. infestans*, de Bary, and the development of oospores. An account is given of the cultivation of *P. infestans* as a saprophyte on various media, on some of which (Oat-Agar and Quaker Oat-Agar) sexual organs are developed. Clinton's discovery of undoubted oospores is confirmed, and the mode of their formation is explained by the process occurring in *P. erythroseptica*.—Prof. J. **Wilson**: Inter-alternative as opposed to coupled Mendelian factors: a solution of the agouti-black colour in rabbits. This is an alternative solution to that given by Prof. Punnett in the November (1912) number of *The Journal of Genetics* as to the agouti-black colour in rabbits. Prof. Punnett found three factors acting conspicuously. On the "presence and absence" theory each of these must have its "absence." Thus there were six in all, and to meet the case two of the three prominent factors had to be coupled. The author finds that there are five factors operating in the case, viz. three dominants and two recessives, but that two of the dominants, and one of the recessives are inter-alternatives—that is, any one of the three can alternate with either of the other two, just as happens with the black, white, and red colours of cattle, or with the colours of horses.—E. G. **Fenton**: Notes on recent pampa and other formations in Patagonia. The author, from his traverses of southern Patagonia, brings forward evidence of widespread glacial and ice-sheet conditions at the close of Pliocene times, followed by a long inter-glacial interval, during which extensive outpourings of lava and emission of exploded materials occurred. This interval, which may have lasted for some thousands of years, was followed by a more local glaciation, when the Andes sent glaciers into the lowlands. The author believes that elevation of the area is now in progress.

PARIS.

Academy of Sciences, March 3.—M. F. Guyon in the chair.—B. **Baillaud**: The publication of certain works of the Paris Observatory.—A. **Lacroix**: The mineralogical constitution of the Los Archipelago (Guinea).—Paul **Sabatier** and A. **Mailhe**: A catalytic method of isomerising the alkyl chlorides and bromides. Chloride of barium or chloride of thorium at 250° C. decompose the alkyl chlorides and bromides into acid and ethylenic hydrocarbon. If this mixture is passed over pumice in the same tube heated to 200° C. these gases re-combine, giving secondary and tertiary alkyl halides. Examples of the application of the method are given.—Charles **Depéret**: Observations on the Pliocene and Quaternary geological history of the Gulf and Isthmus of Corinth.—M. **Barbier** was elected a correspondant for the section of chemistry in the place of the late M. Ladenburg.—Charles **Nordmann**: The light yield of a black body at high temperatures and on that of the stars. First application to Arcturus and Vega. By the application of Planck's and Stefan's laws it is shown that the light yield of a radiating body increases with the temperature to a maximum and then decreases. As a first approximation this temperature is found to be 6430° C., very nearly that found by various methods for the sun. The effective temperature of Arcturus is deduced as 3400° C., and Vega is 2·2 times as great.—M. **Tzitzeica**: Derived reciprocal networks.— J. Le **Roux**: The determination of the harmonic functions. Application to the square.—Mlle. Th. **Tarnarider**: The best approximation of $|x|^{2s+1}$ by polynomials of indefinitely increasing degrees.—Jacques **Chapelon**: The numbers of classes of positive binary quadratic forms.

—Et. **Delassus**: The equilibrium and small movements of systems submitted to linkages of any order whatever.—André **Blondet**: The internal power and synchronising couple of synchronous alternators working on a network at constant potential or in parallel.—Casimir **Cépède**: A new method of mounting microscopic preparations permitting the study of both faces of the section under the strongest magnifications, and doing away with the necessity of special methods of packing. A hole is bored in the glass slide in such a manner that the object can be imbedded between two cover glasses. This allows either side to be examined, and the slides can be packed vertically in contact with each other without danger of damaging the section.—Pierre **Goby**: A new application of the X-rays: microradiography. The apparatus described and figured gives an enlarged radiogram of small objects. Illustrations are given of radiograms from twelve to seventeen times the diameter of the original objects.—G. **Reboul**: Capillary phenomena in gases. Extension of the Laplace formula to solid-gas contact.—Marcel **Boll**: The energy absorbed and mass formed in a photochemical reaction. A study of the conductivity of a very dilute solution of chloroplatinic acid under the influence of a monochromatic radiation.—André **Kling** and D. **Florentin**: The action of low temperatures on explosives. The handling and opening of explosive bombs has frequently to be undertaken in the Paris Municipal Laboratory, and experiments have been made to see if the force and velocity of detonation of various explosives can be reduced by cooling to the temperature of liquid nitrogen. It has been found that the sensibility of some explosives and detonators is reduced by cooling, but when explosion takes place the force of the explosion is not affected by the low temperature.—Victor **Henri** and Marc **Landau**: Study of the absorption of the ultra-violet rays by acetylene. Tables are given showing the positions of the bands produced by the gas and by its solutions.—Witold **Broniewski**: The critical points of iron. Heating curves are given for electrolytic iron and also the results of measurements of the thermo-electric power, electrical resistance, expansion, and thermal points.—L. **Guillet** and A. **Portevin**: Some properties of a commercial electrolytic iron. In this metal no carbon, manganese, silicon, or sulphur could be detected. It contained phosphorus 0·025 per cent., and arsenic 0·011 per cent. Determinations were made of its critical points, and two microphotographs are reproduced.—H. **Pélabon**: Study of the system antimony sulphide, lead sulphide. Definite compounds were shown by the existence of transition points and confirmed microscopically.—Daniel **Berthelot** and Henry **Gaudechon**: A levulose actinometer for ultra-violet light. The influence of the concentration on the velocity of the photochemical reaction. In weak solutions the absorption is slight and is proportional to the concentration; in concentrated solutions the absorption is total, and does not increase with the concentration.—MM. **Lespieau** and **Bresch**: The action of α-β-dichlorethyl ether on mixed magnesium derivatives.—Pierre **Jolibois**: Methyl-magnesium iodide. By the action of heat on methyl-magnesium iodide a substance is obtained of the composition MgI_2,Mg_2C. This is attacked by water, nearly pure methane being evolved.—André **Meyer**: "Halochromy" in the derivaties of phenylisoxazolone and in its indogenides.—Albert **Michel-Lévy**: The eruptive rocks of the Lyonnais.—M. **Mazé**: The relation which exists between the water evaporated and the weight of plant material elaborated by maize.—Eug. **Rousseaux** and Maurice **Sirot**: Soluble nitrogenous material as a factor in valuing flour. In a good flour the ratio between the total nitrogen and the soluble nitrogen should not fall below a certain figure. A low ratio corresponds with bad bread-making properties.—A. **Demolon**: Researches on the fertilising action of sulphur. The fertilising action of sulphur may be attributed to its action on the micro-organisms of the soil and also to its progressive oxidation to sulphuric acid.—L. C. **Soula**: The activity of the nervous centres and nitrogen catabolism of the nerve substance.—Raphael **Dubois**: The nature and development of the light organ of *Lampyris noctiluca*.—Gabriel **Bertrand** and H. **Agulhon**: The presence of boron in the animal kingdom. The authors conclude that boron exists normally in very small proportions in all animals. The amount is greatest in animals of madine origin.—Henri **Stassano**: Contribution to the knowledge of the plasma of propeptone.—H. **Maurice**: The results given by captive balloons north of the polar circle. Temperatures are given on the ground and at varying heights up to 20,000 metres.—E. A. **Martel**: Study of the temperatures of subterranean waters.

BOOKS RECEIVED.

Household Bacteriology for Students in Domestic Science. By E. D. Buchanan and Prof. R. E. Buchanan. Pp. xv+536. (London: Macmillan and Co., Ltd.) 10*s.* net.

Bücher der Naturwissenschaft. Band 15, Vom Keim zum Leben. By Prof. K. Lampert. Pp. 198+xii plates. (Leipzig: P. Reclam, jun.) 1 mark.

Government of India. Department of Revenue and Agriculture. Agricultural Statistics of India for the Years 1906–7 to 1910–11, in 2 vols. Vol. ii., Native States. Pp. 123. (Calcutta: Superintendent Government Printing, India.) 1*s.* 6*d.*

Garden Work: a Practical Manual of School Gardening. By W. Good. Pp. xvi+399+plates. (London: Blackie and Son, Ltd.) 3*s.* 6*d.* net.

Die Methoden der exakten, quantitativen Bestimmung der Alkaloide. By Prof. A. R. von Korczynski. Pp. iv+82. (Berlin: Gebrüder Borntraeger.) 3.50 marks.

Osmotic Pressure. By Prof. A. Findlay. Pp. vi+84. (London: Longmans and Co.) 2*s.* 6*d.* net.

Report of the Librarian of Congress and Report of the Superintendent of the Library Building and Grounds for the Fiscal Year Ending June 30, 1912. Pp. 235. (Washington: Government Printing Office.)

The Mosquitoes of North and Central America and the West Indies. By L. O. Howard, H. G. Dyar, and F. Knab. Vol. i., A General Consideration of Mosquitoes, their Habits, and their Relations to the Human Species. Pp. vii+520. Vol. ii., Plates. Pp. x+150 plates. (Washington: Carnegie Institution.)

Carnegie Institution of Washington. Year Book. No. 11, 1912. Pp. xvi+294. (Washington: Carnegie Institution.)

The Classics of International Law. Edited by J. B. Scott. De Jure Belli ac Pacis Libri Tres, in quibus Ius Naturæ and Gentium, item Juris Publici prœcipua explicantur. By H. Grotius. Vol i., Reproduction of the Edition of 1646. Pp. 618. (Washington: Carnegie Institution.)

Researches of the Department of Terrestrial Magnetism. Land Magnetic Observations, 1905–1910. By L. A. Bauer. Pp. iv+185. (Washington: Carnegie Institution.)

The Vulgate Version of the Arthurian Romances. Edited from Manuscripts in the British Museum by H. O. Sommer. Vol. vi. Pp. 391. (Washington: Carnegie Institution.)

The Nummulosphere: an Account of the Organic Origin of so-called Igneous Rocks and of Abyssal

Red Clays. By R. Kirkpatrick. Pp. 104+2 plates. (London: Lamley and Co.) 2s. net.

V. v. Richter's Chemie der Kohlenstoffverbindungen oder Organische Chemie. Elfte Auflage. Zweiter Band. By Drs. R. Anschutz and H. Meerwein. Pp. xxii+1048. (Bonn: F. Cohen.) 26 marks.

A Guide for Laboratory Geography Teaching, for Use in connection with "A Laboratory Manual of Physical and Commercial Geography," by the late Prof. R. S. Tarr and Dr. O. D. von Engeln. By Dr. O. D. von Engeln. Pp. iii+20. (London: Macmillan and Co., Ltd.) 1s. net.

Elementary Principles of Electricity and Magnetism for Students in Engineering. By Drs. R. H. Hough and W. M. Boehm. Pp. vii+233. (London: Macmillan and Co., Ltd.) 6s.

Garden Flowers as They Grow, Photographed in Colour Direct from Nature. By H. S. Corke, with descriptive text by H. H. Thomas. Pp. iii+197. (London: Cassell and Co., Ltd.) 5s. net.

Heat: a Manual for Technical and Industrial Students. By J. A. Randall. Pp. xiv+331. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 6s. 6d. net.

Cambridge County Geographies:—Herefordshire. By A. G. Bradley. Pp. xi+149. (Cambridge University Press.) 1s. 6d.

University of Calcutta Readership Lectures. Matrices and Determinoids. By Prof. C. E. Cullis. Vol i. Pp. xii+430. (Cambridge University Press.) 21s. net.

Abhandlungen und Vorträge zur Geschichte der Naturwissenschaften. By Prof. E. O. von Lippmann. Zweiter Band. Pp. x+491. (Leipzig: Veit and Co.) 8 marks.

Brands Used by the Chief Camel-Owning Tribes of Kordofán. By H. A. MacMichael. Pp. vii+40+xvii plates. (Cambridge University Press.) 6s. net.

Die Mathematischen Wissenschaften. Erste Lief. Die Mathematik im Altertum und im Mittelater. By H. G. Zeuthen. Pp. iv+95. (Leipzig and Berlin: B. G. Teubner.) 3 marks.

The Fitness of the Environment. By Prof. L. J. Henderson. Pp. xv+317. (London: Macmillan and Co., Ltd.) 6s. 6d.

"Red Books" of the British Fire Prevention Committee. No. 174, Fire Tests with Roof Coverings of Asbestos Cement Corrugated Sheets. Pp. 31. (London: British Fire Prevention Committee.) 2s. 6d.

A Text-Book on Field Fortification. By Col. G. J. Fiebeger. Third edition. Pp. xii+155+xxvii plates. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 8s. 6d. net.

A Text-Book of Experimental Metallurgy and Assaying. By A. R. Gower. Pp. xiv+163. (London: Chapman and Hall, Ltd.) 3s. 6d. net.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College for the Years 1905–1912.—Edited by R. M. Milne. (London: Macmillan and Co., Ltd.) 6s.

Catalogue of the Heads and Horns of Indian Big Game, bequeathed by A. O. Hume, C.B., to the British Museum (Natural History). By R. Lydekker. Pp. xvi+45. (London: British Museum (Natural History); Longmans and Co., and others.) s.

A Revision of the Ichneumonidæ, based on the Collection in the British Museum (Natural History), with Descriptions of New Genera and Species. Part ii. By C. Morley. Pp. x+140+plate. (London: British Museum (Natural History); Longmans and Co., and others.) 5s. 6d.

A Descriptive Catalogue of the Marine Reptiles of the Oxford Clay, based on the Leeds Collection in the British Museum (Natural History). Part ii. By Dr. C. W. Andrews. Pp. xxiv+206+xiii plates. (London: British Museum (Natural History); Longmans and Co., and others.) 25s.

Moderne Probleme der Biologie. By Prof. C. S. Minot. Pp. vi+111. (Jena: G. Fischer.) 3 marks.

Die Weltherrin und ihr Schatten. By F. Auerbach. Zweite Auflage. Pp. 74. (Jena: G. Fischer.) 2 marks.

Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India. (New Series.) No. 57, Studies on the Flagellates of the Genera Herpetomonas, Crithidia, and Rhynchoidomonas. No. 1. By Capt. W. S. Patton. Pp. 21+plate. No. 58, Studies on the Mouth Parts and Sucking Apparatus of the Blood-sucking Diptera. No. 2. By Capt. F. W. Cragg. Pp. 33+plate. No. 59, ditto. No. 3. By Capt. F. W. Cragg. Pp. 36+vi plates. (Calcutta: Superintendent Government Printing, India.) 1s. 2d., 1s., and 1s. 11d. respectively.

DIARY OF SOCIETIES.

WEDNESDAY, MARCH 26.

AERONAUTICAL SOCIETY, at 8.0.—Annual General Meeting, 8.30.—Hydro-Aëroplanes: Commander C. R. Samson, R.N.

THURSDAY, MARCH 27.

CONCRETE INSTITUTE, at 7.30.—Beams and Props for Mines: Prof. S. H. Dixon.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, MARCH 27, 1913.

FOREST PHYSIOGRAPHY.

Physiography of the United States and Principles of Soils in Relation to Forestry. By Prof. I. Bowman. Pp. xxii+759. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1911.) Price 21s. net.

AS the longer title of this work denotes, this is not a book on forestry, but on physiography for students of forestry, and especially for those of the United States. The book is in two parts, the first of which forms a complete treatise on the subject of soils, and it is this part which will be of most interest to foresters and nature-students in this country. The second and larger part is devoted to a description of the United States, according to physiographic regions, in regard to geology, climate, soil, and vegetation.

In reading this book one cannot fail to be impressed by the prominence given to the question of water and water-supply. "Water constitutes from 65 per cent. to more than 95 per cent. of the tissues of plants," and "is the factor that most frequently conditions life and death." Water is also the natural force which is most capable of being controlled by man: by the preservation of soil-cover and by a proper system of drainage promoting its beneficial influences and checking its dangers. In this connection Fernow is quoted as saying:

"The leaf canopy catches and re-evaporates about 12 per cent. of the rainfall, while 10 per cent. of it runs along the tree-trunks and reaches the ground by a circuitous course. The forest litter, the moss-covered and leaf-strewn ground, is capable of absorbing water at the rate of 40,000,000 to 50,000,000 cubic feet per square mile in ten minutes—water whose progress is delayed by some twelve to fifteen hours after the first effects of a heavy freshet have passed."

The author deplores the reckless timber-cutting which has taken place in America during the last twenty-five years, with the result that the soil, "the inheritance of geologic ages," has in many cases been washed away or impoverished. In a striking paragraph, in dealing with the evil effects of deforestation in the southern Appalachians, he writes:

"The rain beats directly upon the soil, the retarding influence of the ground litter and tree-roots is withdrawn, and more rapid soil removal occurs. When once these evil effects have been allowed to take place, mankind is deprived practically for thousands and even millions of years of the favourable conditions that preceded the epoch of destruction. In a hundred years man may achieve such baneful results as nature will compensate only during a geologic period of hundreds of thousands of years. Soil is a resource of priceless value. On resistant rocks its formation is excessively slow. Many glacial striæ formed on resistant rock during the last glacial epoch, roughly 60,000 to 75,000 years ago, are still preserved as fresh as if they were made but yesterday. In that time man has come up from the cave and the stone-hammer. Seventy thousand years is a very short time for the development of a soil-cover; for man it means a period so great that his mind can hardly appreciate it. The earth as we find it in the geologic to-day must be treated with care if the human race is to have a fair distribution of its wealth in time. To the geologic mind there is something shocking in the thought that a single lumber merchant may in fifty years deprive the human race of soil that required 10,000 years to form."

Although forests undoubtedly tend to regulate stream-flow, the author is careful to show that they are not an absolute preventive of flooding, and that in individual cases their influence may be quite insignificant. It is largely a matter of soil and situation, but where soil removal exceeds soil formation, or where the balance between the two is only delicately established, the destruction of forests can only be attended by disastrous consequences.

The chemistry of the soil, the effects of sun, air, wind, the beneficial influences of the lower forms of vegetable and animal life, are each dealt with in a concise though comprehensive manner, and frequent footnotes give authorities for statements made and references to further literature on the various points discussed.

A key-list giving the scientific names of the trees referred to by their common names would be of value, and there are a few minor errors which should be corrected in future editions.

The book is admirably produced, and fully illustrated by diagrams, maps, and photographs, and forms a most useful addition to the literature of the subject. J. W. MACKAY.

THE HIGHWAY OF ANIMAL EVOLUTION.

The Evolution of the Vertebrates and their Kin. By Dr. William Patten. Pp. xxi+486; illustrated. (London: J. and A. Churchill, 1912.) Price 21s. net.

THE author presents in a stately form a detailed account of his theory of the Arachnid origin of vertebrates. He has worked at this persistently since 1884, and in the course of his investigations has made important contributions to our knowledge of Limulus and the Ostracoderms. No one will withhold admiration who looks into the details of comparative anatomy, histology, and embryology with which

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this large and finely illustrated volume is filled, for Prof. Patten has spared no labour in his endeavour to test what seems to him to be an approximate solution of the problem of the evolution of the vertebrates. It may be said at the outset that his theory is quite different from Gaskell's, which, in his judgment, was vitiated by the assumption that the neural surface of an Arthropod is the same as the hæmal surface of a vertebrate.

The general thesis is that "the great Vertebrate-Ostracoderm-Arthropod phylum forms the main trunk of the genealogical tree." Vertebrates arose through Ostracoderms from Arachnid-like Arthropods. One of the important steps was cephalogenesis, numerous anterior metameres being integrated into a "head"—prophetic of the vertebrate head; the old mouth was closed and a new one opened; the bases of the more anterior appendages were forced towards the hæmal surface to form the vertebrate oral arches; the heart was drawn forwards; true gill-clefts appeared; the lateral eye placodes were transferred to the interior of the cerebral vesicle and the optic ganglia to the roof of the mid-brain; and so on.

The Arachnids' forebrain vesicle is formed like that of vertebrates; both have the same sort of pineal eye; Arachnids have a cartilaginous endocranium similar in shape and location to the primordial cranium of vertebrates, and they have an axial subneural rod comparable with the notochord; in Arachnids the brain contains approximately the same number of neuromeres as in vertebrates—these are fair illustrations of the arguments by which Prof. Patten supports his thesis. With his guiding idea of an Arachnid-Ostracoderm-Vertebrate alliance, Prof. Patten feels that the numerous resemblances he adduces have a cumulative convincingness. We must confess that many of them appear to us exceedingly far-fetched, *e.g.* that the "lemmatochord" is comparable to the notochord, and that many others, *e.g.* "endocranium" and cranium, simply illustrate convergence. To the preliminary objection that Arachnids are far too specialised to have given rise to vertebrates, the author gives an answer the point of which we cannot profess to see, that "every animal is a specialised one when compared with its ancestors, and at the same time a generalised one when compared with its descendants."

In regard to the position of other classes involved, Prof. Patten holds remarkable views. The Ostracoderms are intermediate between Arachnids and vertebrates; the Cirripedes are the only members of the Acraniates in which the more typical Arthropod characters are retained; the Tunicates are descended from that particular subdivision of the Arthropods to which the Cirripedes and Copepods belongs; the Echinoderms are also descended from Cirriped-like Arthropods, as may be inferred from the nauplius-like larval form; the Enteropneusta are probably descendants of primitive Arthropods; the Pterobranchs have in certain respects, such as the six pairs of appendages, a decidedly arachnoid character; the Polyzoa may best be interpreted as descendants of primitive Arthropods of the Cirriped type; the Chætognatha are unquestionably primitive Arthropods, somewhat degenerate. Thus we see how the clearing up of the main highway—the Arachnid-Ostracoderm-Vertebrate line—makes the relations of the byways plain! There is much to be said for vigorous heresy, but this is a perversion of morphology. We are minded, however, of the saying of another investigator of the pedigree of vertebrates, that "in morphology everything is important except the hypothesis." In conclusion, we may note that Prof. Patten's researches have made him a convinced "bathmist." The internal processes of differential growth and readjustment are fundamentally important. Environmental influence, natural selection, and the like have played an insignificant subordinate part. "The creative power of internal environment is always present, always active, always changing." We confess to liking this view better than the author's phylogeny.

ZOOLOGY AND NATURAL HISTORY.

(1) *Animal Secrets Told: A Book of "Whys."* By H. C. Brearley. With twelve full-page illustrations from photographs by Elwin R. Sanborn. Pp. xvi+274. (London: Headley Brothers, n.d.) Price 5*s.* net.

(2) *Wild Life in the West Highlands.* By C. H. Alston. With illustrations by A. Scott Rankin. Pp. xi+271. (Glasgow: James MacLehose and Sons, 1912.) Price 6*s.* net.

(3) *The Sheep and Its Cousins.* By R. Lydekker, F.R.S. Pp. xv+315. (London: George Allen and Co., Ltd., 1912.) Price 10*s.* 6*d.* net.

(4) *The Marine Mammals in the Anatomical Museum of the University of Edinburgh.* Part i., Cetacea; Part ii., Sirenia; Part iii., Pinnipedia. By Sir Wm. Turner, K.C.B. Pp. xv+207. (London: Macmillan and Co., Ltd., 1912.) Price 6*s.* net.

(5) *The Growth of Groups in the Animal Kingdom.* By Prof. R. E. Lloyd. Pp. viii+185. (London: Longmans, Green and Co., 1912.) Price 5*s.* net.

"ANIMAL Secrets Told" (1) is a series of popular articles explaining, or attempting to explain, the reason for special variation in the shape and structure of some of the external organs, like the feet, tail, ears, and noses, of certain selected types of vertebrate animals. The book contains much that is instructive and true and suggestive; but some of it is highly imaginative and must not be taken too seriously by the uninformed.

There is not much that is new in Mr. Alston's pleasant little volume (2). It is a collection of essays on a variety of topics ranging from the former existence of the wolf and beaver in Scotland to the value of different colours in the making of anglers' flies. The author is a keen field naturalist, and his ardent advocacy of the protection of indigenous British species of birds and mammals finds expression in the chapters devoted to the sea-eagle, the wild-cat, and members of the weasel tribe. The book concludes with two chapters quite unsuggested by the title. One is upon elephants in Ceylon and the other upon the sheep-killing Kea parrot of New Zealand. In this there is a never previously published account of this bird, supplied to Mr. Alston by Mr. Alexander F. Brown, one of the survivors of the enterprising pioneers of the higher ranges of the South Island.

"The Sheep and Its Cousins" (3) is the outcome of work Mr. Lydekker has been doing for some years in carrying out Sir Ray Lankester's wise scheme for preserving permanent records of breeds of domesticated animals by exhibiting mounted specimens in a special gallery in the Natural History Museum. Mr. Lydekker has made good use of the opportunities afforded by his official position in that institution to get together examples of many rare forms of sheep, about which most zoologists had previously nothing beyond bibliographical knowledge. An account of these, together with descriptions of the principal European breeds and summaries of the highly speculative views of authors touching their origins and affinities, about which practically nothing is known, forms the greater part of this volume, which will form a useful guide for a more thorough and scientific treatise on the subject.

In connection with the oft discussed, but quite unsettled, question of the origin of tame sheep, one cannot suppress a feeling of envy at the assurance with which their differences from wild species are lightly dismissed as due to domestication; and one wonders if Mr. Lydekker realises that his adoption, or seeming adoption, of the view that they are descended from two or more distinct species involves the conclusion that their common characters must have been independently developed at least twice. It may be so; but the evidence for this amounts at present to very little. About the treatment of the wild species, one is at a loss what to say, except that if the author really knows them, apart from their geographical distribution, he has been very unjust to himself. Presumably, the scientifically indefensible inclusion of the Audad (Ammotragus) and the Bharal (Pseudoïs) in a volume devoted to sheep (Ovis), from which goats (Capra) are excluded, is a concession to popular terminology; but since Mr. Lydekker calls them "aberrant sheep" one suspects that he scarcely appreciates rightly the distinguishing characters of these four genera. Naturally, the book is not free from mistakes. For instance, it is stated that the female Bharal lacks at all ages the dark markings of the male. Probably this is never true. Certainly it is not always true. This and other errors, however, will no doubt be corrected in future editions.

(4) In compiling a catalogue of the skeletal and anatomical remains of the Cetacea, Sirenia, and Pinnipedia belonging to the University of Edinburgh, Sir William Turner has taken the opportunity of putting into the hands of zoologists an invaluable monograph containing brief definitions of the families, genera, and often of the species of these three orders, as well as descriptions of the chief osteological, dental, anatomical, and fœtal preparations in the rich collection at his disposal. A surprising amount of information is packed into the two hundred odd pages of the volume, and when one adds that it is illustrated with seventeen plates and more than one hundred text figures, no further evidence need be adduced of its usefulness to students of these orders.

For the classification of the Cetacea, the author has paid special attention to the characters displayed by the fronto-naso-premaxillary region, the rostrum, the hard palate and pterygoids, the teeth and the tympano-periotic bones, and, in the introduction to this order, the principal modifications of these parts of the skull in different genera are briefly detailed. The rest of this introduction contains an account, equally interesting to naturalists and zoologists, of species of whales stranded on the coast of Scotland both in recent times and in the prehistoric period before the land and sea had assumed their present level.

The aim of Dr. Lloyd's book (5) is, as he tells us, to lessen the belief in natural selection as a creative agency, and its pages are devoted mainly to pointing out the variations in colour and other characters presented by the common black rat (*Mus rattus*) in India. Exceptional opportunities for this valuable piece of statistical research work were afforded by the campaign against these pests undertaken by the Plague Commission in 1907, examination of the material sent to Calcutta being part of Dr. Lloyd's work.

He shows amongst other things that variation in the colour of certain areas, especially of the ventral surface and of the tail, is discontinuous and that not infrequently several individuals differ from the ordinary run of rats in a particular district by a combination of characters similar to those used by systematists for discriminating species or subspecies of Muridæ. In the case of *Mus rattus* it is tolerably evident that these individuals are members of a family party; yet, as Dr. Lloyd insists, if a similar series of individuals were to emanate from a "field" species of Mus and were to fall into the hands of a systematist, they would probably be regarded as representatives of an undescribed form and be named accordingly; and in that case they might for ever remain the sole examples of the species or subspecies, so-called. On the other hand, such a series might by isolation in their locality give rise to a persistent type. Dr. Lloyd discusses the question of the origin of "species" from mutants, and expresses the opinion that species have arisen in that way, irrespective of natural selection; and it seems that he would lessen, to that extent at all events, the belief in natural selection as a creative—one would have preferred "guiding" or "fostering"—agency. He also supports his case by citing Tower's records and statistics touching the potato beetle. His views are clearly and modestly put forward, and his book is worth careful attention, although the omission of an index, of a table of contents, and even of headlines to the chapters makes the reading more difficult than it need have been. R. I. P.

METALLURGICAL INDUSTRIES.

(1) *A Text-book of Rand Metallurgical Practice.* Designed as a "Working Tool" and Practical Guide for Metallurgists upon the Witwatersrand and other Similar Fields. By Ralph Stokes, Jas. E. Thomas, G. O. Smart, W. R. Dowling, H. A. White, E. H. Johnson, W. A. Caldecott, A. McA. Johnston, and C. O. Schmitt. Vol. ii. Pp. xxii+438. (London: C. Griffin and Co., Ltd., 1912.) Price 21*s*. net.

(2) *The Technology of Iron Enamelling and Tinning.* Being Collected Papers. By J. Grünwald. Translated from the German by Dr. H. H. Hodgson. Pp. viii+139. (London: C. Griffin and Co., Ltd., 1912.) Price 6*s*. net.

(3) *Notes on Foundry Practice.* By J. J. Morgan. Pp. ix+108. (London: C. Griffin and Co., Ltd., 1912.) Price 2*s*. 6*d*. net.

(1) THE second volume of this work is by Mr. C. O. Schmitt, and consists of two sections—"The Design and Construction of Reduction Plant" and "The Transport of Material"—the latter naturally being the smaller, occupying the last hundred pages of the book.

The first section deals in a systematic manner with the reduction plant used on the Rand, taking in order the breaking plant, stamp mill, tube mill, sand plant, slime plant, and precipitation plant, and the author has covered this ground very thoroughly, giving much useful information; for instance, when considering the design of a reduction plant, the value of a volume diagram and a flow sheet, in addition to the plan and elevation of the plant, is pointed out. The chapter on "Sorting and Breaking Plant" is good, the subject being fully discussed, while under "Crushing Plant" there is a comprehensive description of the stamp mill found on the Rand, all various parts of the battery being considered.

The section on the modern foundations for mortar boxes is particularly instructive and is well illustrated. The "Nissen" stamp mill, which has recently been run experimentally at the City Deep, is briefly described. A most adequate account of the Rand cyanide plant is given, and it should be of use to all engaged in the cyaniding of gold ores, for the cyanide process has proved a most satisfactory means for the further treatment of the Rand ore, with the result that there have been great developments in the plant. An important chapter on "Estimating" is included, and the author of this volume rightly insists that a detailed estimate of the cost of a plant which has been designed is essential, and for this purpose gives a set of useful schedules.

In the second section of the book the plant for the transport of material is fully described, the methods of handling ore, dry sand, dry slime, pulp and sand residue being given. This section should be of general interest to mining and metallurgical engineers, for the lack of labour on the Rand has made mechanical handling of material a necessity; consequently a large number of appliances is considered.

The volume is copiously illustrated, and contains many useful tables and valuable diagrams as well as a good bibliography.

The work is, as the authors claim, a "practical book for practical men," and, although dealing with the metallurgical practice upon the Witwatersrand, will be of value to those engaged on goldfields where some of the conditions are similar. The advanced student who is studying the metallurgy of gold will find it a useful book, for it will broaden his outlook, give him an insight into industrial problems, and will put before him information gained by practical experience. The book can be thoroughly recommended.

(2) These papers form valuable contributions to the technology of iron enamelling, for particular problems or aspects of the industry are considered; but, so far as the technology of tinning is concerned, there are only three papers: one historical, another on the grey allotropic modification of tin, and the third giving short accounts of processes for the recovery of tin from tinned waste.

The papers which deal with the composition of various enamels and their mode of manufacture are the most important, and much information, gained by actual experience, is given. As very few works in the enamelling industry employ chemists, a paper showing how the chemical composition of an enamel may be determined by calculation has very wisely been included in the series. The paper with the title "The Examination of Cast-iron Enamels" has not been happily named. The translator is to be commended on the satisfactory manner in which he has carried out his work. Managers of enamel works and all those concerned with the problems of the enamelling industry will find much valuable information in these papers.

(3) This work deals chiefly with iron-founding, and gives a general description of the materials used, the methods adopted, and the appliances employed. The influences of the various elements usually present in cast-iron are discussed, and several analyses of pig-iron are given. The cupola and other foundry furnaces are briefly but clearly described, and an exceedingly good and concise description is given of moulding-sands and moulding. It would have been an advantage to have placed the sections on moulding-sand and openers later in the book, so as they would precede "Moulding." The book should prove very useful to technical students and to engineers who wish to gain a general idea of foundry practice.

OUR BOOKSHELF.

Die sanitarisch-pathologische Bedeutung der Insekten und verwandten Gliedertiere, namentlich als Krankheits-Erreger und Krankheits-Ueberträger. By Prof. Emil A. Göldi. Pp. 155. (Berlin: R. Friedländer und Sohn, 1913.) Price 9 marks.

Here we have a clear and compendious account of the Arthropods concerned in the causation of disease, particularly of tropical diseases. It will, perhaps, be more useful in the class-room than in the laboratory, since, though the author is very sound in his appreciation of the entomological factor in pathological research, he treats his Arthropods by a sort of criminatory standard peculiarly profitable to the novice.

In the first section the Arthropods that bite and sting in their several ways are dealt with, the structure of the organ of offence and the nature and effects of the injury being described in every case. Here is included a multitude of figures of urticating caterpillars from South America. It will surprise those who know only the scorpions of the Old World to learn from the author that from 200 to 250 children are killed annually in Mexico alone by scorpions.

A second section is concerned with Arthropods as parasites of man. These are differentiated as occasional bloodsuckers so far as man is concerned, such as mosquitoes, gadflies, &c.; professional bloodsuckers, such as Stomoxeinæ, bedbugs, &c.; and thoroughgoing parasites, such as lice, fleas, bots, ticks, &c. The means and methods of offence and the effects of the parasitism are discussed; and the various kinds of parasites are described and figured, so as to make clear not only their general appearance, life-history, and metamorphoses, but also many necessary and contingent anatomical details.

The third section treats of Arthropods as carriers of specific pathogenic micro-organisms. Here the text is plentifully illustrated with figures of notorious micro-parasites in their various phases, of the infected tissues and organs of the specific Arthropod carrier, and of the disastrous effects upon the ultimate victims—men and domestic animals.

The book is written in a crisp and (if the adjective may be allowed in this connection) attractive style, and is well printed.

Grundzüge der allgemeinen Phytopathologie. By Dr. H. Klebahn. Pp. 147. (Berlin: Gebrüder Borntraeger, 1912.) Price 4.80 marks.

Prof. Klebahn's high reputation as a research worker in mycology leads one to expect in a book from his pen exactly what one finds in this volume: an admirable combination of clearness and terseness, the essentials of the subject being presented in a striking manner and the details of minor importance lightly touched upon or omitted. It is safe to assert that never has such an accurate, interesting, and philosophical account of the various diseases which afflict cultivated plants been compressed into fewer than 150 pages, and that this is probably the best general introduction to the study of phytopathology that has yet been published.

The book is characterised by its scientific rather than technical treatment of the subject, the author laying stress upon the necessity for a thorough understanding of the symptoms and causes of plant disease as a preliminary to the application of therapeutic and prophylactic measures, and he has deliberately limited his scope to pure pathology. Before proceeding to consider the diseases induced by fungi, insects, and other organisms, he discusses chemical and physical conditions of the soil, climatic conditions, wounds, smoke, and chemical fumes as causes of disease in plants;

and the wide view which is taken of the subject is further reflected in the sections at the end of the book devoted to non-parasitic diseases (caused doubtless by disturbances in physiological balance generally and in enzyme secretion particularly) and to various abnormalities in growth.

F. C.

The Bradshaw Lecture on the Biology of Tumours. By C. Mansell Moullin. Pp. 39. (London: H. K. Lewis, 1913.) Price 2*s.* net.

MR. MANSELL MOULLIN has published as a booklet the Bradshaw lecture which he recently delivered before the Royal College of Surgeons. It treats of new growths or tumours from the biological point of view; he regards the division of them into malignant and innocent as a mere useful convention; there is no sharp line of demarcation between the two groups. He prefers a division into those which spring from germ-cells and possess a more or less complete individuality, and those which spring from somatic cells and are due to escape from control of what remains to them of their primitive form of growth. The short course of an hour's lecture precluded any full treatment of this large subject. The various theories of malignancy are not discussed, but the parasitic nature of cancer is denied. With regard to cure, we have the confession that at present the surgeon's knife is the only safe remedy, though the lecture concludes with the hope that this will not always be so. No reference is made to the part chemistry has played or will play in the elucidation of the cancer problem. Until we know what are the biochemical or metabolic actions in the cells of a new growth, we can scarcely hope to grapple with the methods which will ensure recovery.

W. D. H.

The Physical and Political School Atlas. By J. G. Bartholomew. Pp. xvi of uncoloured maps and texts; 32 coloured maps. (London: Oxford University Press, 1913.) Price 1*s.* net.

THIS cheap and trustworthy atlas may be commended to the attention of teachers of geography. The attempt in some cases to show land relief and other physical features as well as the political geography of a country on one and the same map has led to overcrowding and indistinctness. Where this mistake has been avoided the maps are bold, clear, and convincing.

"Half-inch to Mile" Map of England and Wales. Sheet 3. Cumberland, &c. New and revised edition. (Edinburgh: John Bartholomew and Co., n.d.) Price, in case: 1*s.* 6*d.* paper; 2*s.* on cloth, or 2*s.* 6*d.* on cloth dissected.

LIKE other maps in this excellent series, this of the Lake District is reduced from the Ordnance Survey, and has been revised to date. The map is coloured in the now familiar browns and greens, and in consequence the surface relief can be understood with ease. All details likely to be required by tourists and sportsmen are indicated, and altogether this sheet well maintains the high reputation of the series.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Falling Birth-rate.

IN her lecture, delivered at University College, London, on February 25, Miss Elderton, of the Galton Laboratory, in dealing with the falling birth-rate, pointed out that the decrease is least acute in the mining districts; the engineering trades, which represent the best paid of the artisan class, come next; while textile districts coincide with residential districts in showing the biggest decrease; and she asks if there is some cause which operates to a special degree in certain classes.

One important operating cause, no doubt, is the large and increasing number of women employed in the textile trades. On the other hand, with the exception of a few pit-brow girls, practically no females are employed in the mining and engineering industries; and it is, therefore, perhaps scarcely surprising to find a greater birth-rate amongst the wives of miners and engineers than amongst the women in the cotton and woollen districts. The married woman operative in the Lancashire cotton mills, for example, knows that each new addition to the family entails some weeks' loss of work and wages before and after her confinement, and it also means an increased weekly charge when the baby is, according to Lancashire custom, "put out to nurse"; and no doubt this knowledge acts as a considerable check upon the birth-rate.

The decrease in the residential districts is due, no doubt, in part, to the "increase in luxury of living and love of pleasure" referred to by Miss Elderton, and in part also to the comparatively large number of women who are employed in such districts in domestic service. The rise in the average marriage age must also be taken into account.

Nor must we forget the influence of education. It is worthy of note that the fall in the birth-rate in this country practically dates from the passing of the Education Act in 1870. This new influence would make itself felt in a variety of ways. The check on the employment of child labour, for example, would tend to act as a check on the birth-rate, for whereas formerly children became wage-earners at a very tender age, they would, after the passing of the Act, not only cease to be wage-earners, but would actually be an increased charge on the parents. The increase in the knowledge of physiology, which has spread in recent years as a result of free education, may also not be without its influence.

Yet another factor—again ascribable not very indirectly to free education—is the change in religious sentiment which has been so pronounced during the last quarter of a century. Among other things, people are beginning to doubt whether, in these days, the "quiver full" of children is the unqualified blessing which the Psalmist declared it to be. They are realising that it is better to be the parent of two or three children, well provided for, than of a half-score or so of starvelings.

Miss Elderton also tells us that "a further analysis of figures for several northern towns shows generally that the higher the wages the smaller the family." This is exactly what, other things being equal, one would expect. If we look to the animal world we shall, broadly speaking, find that as we rise from the lowliest to the highest organisms, there is a steady decrease in the number of offspring, while at the same time there is a lengthening of the period during which the offspring remain under the care of the parents. In the case of the human race we find that increasing civilisation brings with it a decreasing birth-rate, and a lengthening period of "schooling" for the children; and it is amongst the least intelligent (which is also usually the lowest paid) section of the community that the birth-rate is the highest. A glance at the birth-rate of our English towns will show that in those districts where there is greatest poverty and congestion, there tends to be also a comparatively large birth-rate.

The foregoing views would seem to be borne out by the fact which Miss Elderton mentions, that Liverpool, "which is not a cotton town, and where the amount of irregular and casual labour is singularly large, is one of the two cases in Lancashire where the birth-rate shows a rising tendency," and also by her statement that "from Bradford figures have been obtained showing how in homes where the mother's health or habits are bad, or where the ventilation is bad, there is on an average about one child more than in homes where these features are good."

To quote the words of Dr. Saleeby, "a chief factor of progress has been the supersession of the quantitative by the qualitative criterion of survival-value. The principle of the fall of the birth-rate is one of the great consistent facts of organic history, and may be traced from the bacteria upwards, through such representative invertebrates as the insects, even through fishes, the first vertebrates, up to man, and amongst the various nations and strata of human society. The tendency of progress, in short—a tendency coincident with the evolution of ever higher and higher species—is to pass from the horrible Gargantuan wastefulness of the older methods towards the evident but yet lamentably unrealised ideal—that every child born shall reach maturity. . . . All organic history proves that a low birth-rate is a mark of high vital level."

J. Anderson.

17 Laburnum Road, Gorton, Manchester,
March 5.

The above letter contains no addition of any ascertained *fact* to those cited by Miss Elderton. Miss Elderton, in her lecture, brought forward a very large amount of evidence to show that the *net* family of the socially less valuable members of the working-classes was larger than that of the socially more valuable members of the same classes. That within a given species the individuals of inferior physique and mentality have relatively greater fertility must mean the degeneration of that species; and no scientific argument can be opposed to this based upon the illogically extended syllogism: "higher" species have lower birth-rates; there is a lower birth-rate in the more valuable members of the artisan classes; hence this tends to convert those classes and their nation into "higher" types of life.

If we start to reason from analogy of this kind, we might argue that the elephant would in the end supplant man, or that the mastodon—for aught we can say to the contrary—ought to have survived all his contemporaries. It is the old fallacy of the Neo-Malthusians, who have never made any real attempt to grasp the race suicide involved in the survival of the unfit by reproductive selection—*i.e.* by their greater fertility, when it is unchecked by natural selection. Argument from analogy, when data are available, is always idle; argument from what is known of species to what must hold of individuals is still more fallacious.

Lastly, association is not causation; a "higher" individual may have fewer children, but this does not demonstrate that his height (however that vague word be defined) is produced by his lesser fertility, or that a race with a large section of its "higher" individuals practically sterile will survive in the battle of nations. History shows many cases of the decline of nations whose intellectually abler members were sterile. I can recall no case of a race with a very low birth-rate maintaining or creating a position for itself in the assembly of nations.

I have not trespassed on your space by commenting on Mr. Anderson's other statements. He was clearly not present at Miss Elderton's lecture, or he would have been aware that her data were all based on *married* women, and had due reference to their *ages*. While the actual birth-rate of wives, fifteen to forty-five years of age, has fallen 30 per cent. to 50 per cent., the *potential* birth-rate of the same wives has fallen a few points, or in many districts not at all.

Karl Pearson.

Galton Laboratory for National Eugenics,
University of London, March 11.

The Radio-Elements and the Periodic Law.

In his letter in Nature of March 20 Mr. Soddy states that "granting the possibility of the existence of groups of elements with identical chemical properties and spectra, the only known direct manner in which the existence of the members of these groups could be separately recognised is radio-active evidence." I should like to suggest that another possible method of distinguishing such elements is provided by their characteristic X-radiation. According to Rutherford, the γ-radiation emitted by a radioactive element is identical with its characteristic X-radiation; is the γ-radiation of thorium D identical with the characteristic X-radiation of thallium, or the γ-radiation of radium D with the characteristic X-radiation of lead? From such experimental results as I can discover after a brief search, it would appear that the answer to this question is in the negative.

It seems probable that a difference might exist between the characteristic X-radiations of elements chemically identical, for the properties of that radiation, like the radio-active properties, are probably determined by the fixed electrons, forming part of the permanent structure of the atom, since both sets of properties are independent of chemical combination; on the other hand, the chemical properties are probably determined by the valency electrons which are readily detached from the atom. If chemically identical elements have the same spectra, it would appear that the spectra are also determined by the valency electrons, a conclusion contrary to that involved in Stark's theory of the origin of spectra.

Norman R. Campbell.

Leeds, March 23.

The Occurrence of the Archiannelid, Protodrilus, on the South Coast of England.

The discovery of the presence of the Archiannelid, Protodrilus, on the English coast is an interesting fact inasmuch as it extends the known domain of a genus of an archaic group of animals, and also adds a valuable animal to our records. So far as is known

Protodrilus appears to inhabit only the European seas,[1] having been taken in the Black Sea, the Mediterranean, at Heligoland in the North Sea, and at Ambleteuse, on the French side of the Straits of Dover. Protodrilus was found on March 2 in a small bay just outside and to the east of Plymouth Sound. On March 11 the spot was again visited, and a large number of specimens, more than a hundred, gathered in about an hour. The animals were found almost at the high-water mark among stones and gravel at a point where a small stream of fresh water runs into the sea.

It is an interesting fact that the animals are immersed at one period in practically fresh water, and at another period in sea water; samples of the water in which the animals were living taken at low water during the neap and spring tides were found to have densities as indicated by a hydrometer of about 1·001 and 1·009 respectively; while the density of a sample of sea water taken just outside the breakwater at Plymouth, estimated by the same instrument, was found to be about 1·025.[2]

These specimens of Protodrilus are undoubtedly different from those previously taken at Ambleteuse and Heligoland, but they resemble in some characters both the Mediterranean forms, *Protodrilus flavocapitatus*, Uljanin, and *Protodrilus spongioides*, Pierantoni. The former of these species occurs in situations which are never covered by more than a few decimetres of water, while the latter is represented by only four specimens taken from fresh water. A fuller investigation of the English specimens is being undertaken in order to compare them in more detail with the known species of this genus.

The English Protodrilus were living in the situation described above along with *Gammarus marinus*, an Oligochæte and *Gunda* (*Procerodes*) *ulvae*; the latter of these species was first taken in this spot in great numbers two years ago, and does not appear to have been recorded previously on the English coast.

J. H. ORTON.

The Laboratory, Citadel Hill, Plymouth.

[1] U. Pierantoni, "Fauna und Flora des Golfes von Neapel." Vol. xxxi. Protodrilus. 1908.

[2] These values of density were made at temperatures between 15° and 17° C., and are to be regarded as approximations only to the absolute density: as the water in which the Protodrilus were living would be constantly changing, it was not considered worth while to analyse accurately two random samples.

On the Gain of Definition obtained by Moving a Telescope.

THE following is an account of a very singular fact which came recently under my notice, and for the explanation of which I am absolutely at a loss.

I am in the habit of rating my chronometer by means of the time-ball dropped at the Greenwich Royal Observatory, about $3\frac{1}{8}$ miles away, a signal which I observe in a small hand telescope.

On March 11, the weather being misty, I failed to pick the signal post, although I knew exactly where it was, and had placed the telescope exactly in the right direction. I moved the telescope a little, thinking I had displaced it in putting my eye to the eyepiece, and I immediately saw, very dimly, the dome of the observatory, and the signal, with the ball at half-mast, and noticed that *they were in the centre of the field all the time*. As soon as I steadied the telescope, however, they vanished completely. They reappeared as soon as I began to "sweep" for them, but remained discernible only while the motion lasted. I repeated the experiment several times; the signal was really invisible while the telescope was fixed, but by imparting to it a slow oscillation right and left I kept the signal in view with sufficient distinctness to see the ball drop, although I was not certain it had really dropped until a second or so afterwards, owing to the great faintness of the image observed.

I recollected then that, often, in similar conditions of seeing, having picked the signal without any difficulty *while "sweeping" for it*, I had failed to see it afterwards, and gave up the attempt, thinking I had been mistaken, or that the mist had become thicker. I have therefore no doubt as to this most curious and inexplicable fact: an indistinct object is better seen in a slowly moving telescope than in the same telescope when kept steady. There must be a very interesting physiological property of the eye involved in producing this result, which is quite in opposition with what one would naturally expect. Perhaps some of your readers have noticed something similar, and could throw a little light on this mysterious phenomenon.

M. E. J. GHEURY.

Woolwich Polytechnic, March 15.

Four-horned Sheep.

MR. RITCHIE's note on four-horned sheep in NATURE of March 6 is interesting, but I am inclined to doubt whether there ever was, in Scotland or any other country, a breed in which four horns are normal. No doubt it is possible to fix this character in the male sex by careful selection, as has been done by some breeders of the spotted or Barbary sheep (sometimes called Spanish, Syrian, or Zulu sheep); but even these have not succeeded in fixing the character in the female sex. I have evidence, in the shape of specimens or photographs, of the existence of four-horned sheep in North and South Africa, Mongolia, China, the Himalayas, Baluchistan, and Chile. The Iceland breed was supposed to be four-horned, and no doubt four-horned examples were often found amongst them, a specimen I have being precisely similar in type to an abnormally four-horned Shetland.

My own experience of four-horned rams is that in most cases the lower horns, and in some cases the upper also, require to be cut at some time in their life to prevent them from growing into the cheek, or below the jaw, so that the animal cannot graze; and this no doubt would have a tendency to eliminate the four-horned rams where not specially selected. No instance is on record, so far as I know, of any wild sheep having more than two horns, neither have I seen any skull of domestic sheep in which there were more than four horn-cores, though five-, six-, and even eight-horned sheep have been recorded.

H. J. ELWES.

Colesborne Park, near Cheltenham, March 14.

THE EXPERIMENTAL STUDY OF FLUID MOTION.[1]

MANY attempts have been made to study the motion of fluids past an obstacle by experimental methods, and experiments made for this purpose may be divided roughly into two classes:

(*a*) Those in which the fluid is made to flow

[1] The figures which accompany this article are from the Technical Report of the Advisory Committee for Aeronautics for the year 1911–12, and are reproduced with the permission of the Controller of H.M. Stationery Office.

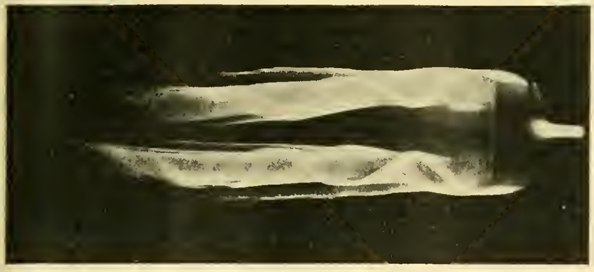
FIG. 1.—Low velocity type of flow. Air.

through a channel past a model which is fixed in the channel.

(*b*) Those in which the fluid is at rest in the channel, the model being moved relatively to the fluid and channel.

In both methods great difficulties are met with if the velocity of flow be high, owing to the rapid movements of the fluid, but in the first method the fact that in a channel the flow becomes turbulent when the critical velocity is reached makes observation at high velocities almost impossible.


FIG. 3.—Low velocity type of flow. Water.


FIG. 2.—High velocity type of flow. Air.

During the past two years a research on fluid motion has been in progress at the National Physical Laboratory, and a brief description of some of the experiments which have been described in the report of the Advisory Committee for Aëronautics may be of interest.

The Teddington experiments have all been made in the "flowing fluid" type of channel, the flow in both air and water being studied at velocities below the critical velocities of the channels used.

A number of methods for indicating the direction of motion of the fluids have been tried, and, up to the present time, the best results have been obtained:

1. *In air*, by allowing tobacco smoke to issue from a jet at the velocity of the surrounding air stream, on the upstream side of the model under investigation.

2. *In water:*

(*a*) By coating the model with condensed milk, which is washed off into the eddying regions, making visible the movements of the fluid in those regions.

(*b*) By introducing minute particles of oil (aniline and toluene) of the same density as the surrounding water, the direction of motion of these particles being recorded photo-

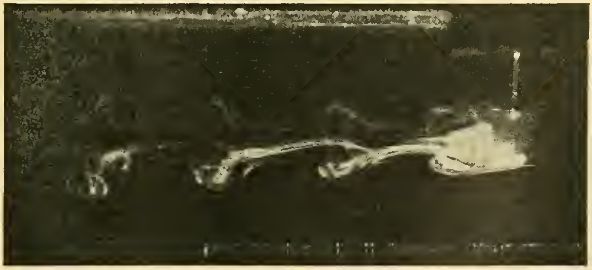
FIG. 4.—High velocity type of flow. Water.

graphically. It should be noted that these photographs, which are short-time exposures, indicate not only the direction of motion in any region, but also the velocity of motion, which is obtained from measurement of the length of the lines, comparison being made with the length of the lines in the open channel where the velocity is known.

Some examples of the results obtained are shown in the accompanying photographs, which are taken from the report of the Advisory Committee for Aeronautics, 1911–12.

FIG. 7.—De Havilland strut.

FIG. 5.—Flat plate.

Figs. 1 and 2 show the flow past an inclined square plate in air at two different velocities (by method 1). Figs. 3 and 4 show the same types of flow in water (by method 2 [a]). Figs. 5 and 6 show the flow past a plate in water (by methods 2 [a] and [b]). Fig 7 shows the flow past a strut in water (by method 2 [b]). Fig. 8 shows the dead region which exists, even at low velocities, at the tail of an airship model.

The last figure is of some interest, as it has been found that where a dead region exists at the tail of a fish-form model, the resistance of the model is not appreciably affected by the shape of the tail within this region, and so long as the tail is sufficiently blunt to cause the formation of "dead air" (as is usually the case in airships, aëroplane hulls, struts, etc.) it is convenient for constructional reasons to end the tail rather abruptly once the boundary of the dead region has been passed.

FIG. 8.—Dead region at the tail of an airship model.

FIG. 6.—Flat plate.

A dead region is always an indication of high resistance, and is therefore undesirable.

It is hoped that observation of the flow past models, together with resistance measurements, will in the near future supply the data necessary to enable the designer of aircraft to construct fish-form bodies of low resistance and high efficiency.

C. G. E.

LIVINGSTONE AS A MAN OF SCIENCE.

NOW, as in the year 1874, which followed his death, discussions are being carried on as to whether Livingstone was more a missionary of religion than a man of science or an enthusiastic and skilful geographer. Such contentions are a waste of argument. Livingstone ardently believed in the supreme value of Christian ethics and the power of undenominational, basic Christianity to raise the backward peoples to a happier condition of life; but to his broad mind—a mind fifty years in advance of most of its contemporaries—reasonable religion and honest science were the same thing. Most of the dogmas of his day—for which people were still being persecuted—he tacitly ignored as being either unprovable or so little essential to "true religion and undefiled" as not to be worth discussion.

If Livingstone had lived seventy years later, he would probably have sought for some science scholarship or endowment and have gone out in his religious search for knowledge as a layman, a layman of that most holy profession, the healer of disease. He had about him the making of another Darwin. As it was, he chose the path of the missionary, and fortunately selected that missionary society (the London) which had already produced men like Campbell and Moffat, and which left with its agents singular freedom of movement and judgment. Consequently, he was able to enrich science with much material for the comprehension of Africa, even when working as a missionary at a modest salary of 100*l.* a year.

No one has ever charged Livingstone with neglecting to do the work of this profession. He taught, he expounded, he translated, pleaded; and exercised a most potent influence for good over the minds of thousands of savages; impressing their chiefs, moreover, so strongly with the worth of his character and the exemplar of his own hard-working, blameless life, that he really laid firm foundations for the Christian civilisation which has now laid hold on Bechuanaland. But from the moment of landing in South Africa he stored up all the observations he could put into writing on the African flora, fauna, geology and native races.

A review of his work as a practical philanthropist, a consul and a geographer has been already dealt with by various writers during the month which preceded the centenary celebrations. Perhaps the best and the most novel treatment of these aspects of Livingstone is that given in three articles by Mr. Ralph Durand in *The African Mail*. *The British Medical Journal* has published an essay on the medical and surgical skill of Livingstone and his great ability in this profession, besides his anticipation of the modern treatment of malarial fever and the cogency of his researches into tsetse-fly disease. To get an all-round view of the capacity of this remarkable man there only remains to be considered his quality in other branches of scientific research—philology, ethnology, zoology, botany, geology and meteorology.

In about a year after arriving in South Africa he had mastered the Sechuana language and had acquired a vehicle for conversation with the tribes between the Orange River and the Upper Zambezi, the Limpopo and Lake Ngami; for many of the Bushmen could speak some Sechuana dialect, and the conquests of the Makalolo (a Basuto tribe) had carried the Sechuana tongue northwards almost to the verge of the Congo basin. But Livingstone, appreciating the great interest which the Bantu language-family possessed for philologists, busily collected vocabularies of the still little-known languages of Ngamiland and the western Zambezi; and though these are either stored at the Grey Library at Capetown or lost, they served the purposes of Dr. W. I. Bleek in assisting him to compose his unfinished "Comparative Grammar of the South African Languages." Ethnology owes a great debt to David Livingstone. It is impossible to write on the races of South Africa without quoting from his stores of information—information which is exact, unemotional, graphic and discerning. He wrote on the Stone Age in Central Africa before anyone had thought of such a period in negro culture; on the ancientness of pottery among the Bantu; on the domestic animals of south Central Africa; on fragments of unwritten history and half-forgotten migrations; on the importance of the Pleiades as a measurer of the seasons in the eyes of the African agricultural folk; on the racial and cultural influence of ancient Egypt on negroland.

His notes on the life-history and habits of the lion, ratel, giraffe, rhinoceros, buffalo, elephant, giant chimpanzi, baboon, hippopotamus, zebra, lechwe, situtunga, and the other striking mammals of southern and Central Africa, are strewn through his three published books, and have done good service in many a natural history book. No succeeding naturalist traveller has called his information in question. Amongst his discoveries in zoology were several antelopes and the pygmy elephant of the Congo forests, "a small variety, only 5ft. 8 in. high, yet with tusks 6 ft. 8 in. in length." (This form was only rediscovered by the Germans a few years ago.) Livingstone's notes on birds, lizards, snakes and frogs are as good reading and as accurate as those on mammals. His observations on the part played in the economy of nature by the termites (which consume and cover with soil all dead timber) were subsequently confirmed and elaborated by the late Prof. Henry Drummond.

Livingstone's botanical collections and innumerable botanical notes—more especially about the Zambezian flora—are incorporated in the old and the new editions of the "Flora of Tropical Africa." His discovery of fossil Araucarias in the rocks of the Central Zambezi valley led him to guess at the ancient connection between South Africa, Australia and South America. His sketch of the geology of Central Africa, written in 1857, his description of the former plutonic activities of the south-west Tanganyika region, of the coal-bearing strata of the Ruvuma and west Nyasaland, and his hearsay reports of the gold and copper of Katanga have stood the test of time in their substantial accuracy. His meteorological records of the rainfall, temperature and climate of Central Africa still await publication.

Indeed, it is possible that much of Livingstone's scientific research work has never yet been published, and that when it is disinterred and printed we may find ourselves still further indebted to this missionary-consul-explorer for valuable information about the southern third of Africa.

H. H. JOHNSTON.

PLANT DISEASES AND INSECT PESTS.

MOST of the investigations on this subject are carried out at agricultural research institutions and have for their primary object the discovery of means for destroying the pest, rather than the elucidation of the relationship between the host and the parasite. Yet the latter problem must be of extraordinary interest, and we can only hope that the investigators will turn to it as soon as some of their pressing economic problems are solved.

Of the British Colonial departments, the West Indian is among the most prolific in publications on these subjects. The papers are issued in the reports of the various schools and departments and in *The West Indian Bulletin*. No. 4, vol. xii., of this journal contains papers by H. A. Ballou, J. R. Bovell, and F. W. South on the use of entomogenous fungi in combating scale insects in Barbados, one of the most interesting methods of pitting one organism against another for the benefit of mankind. Fungi parasitic on the insects are cultivated and the spores distributed: they are then applied to the insects directly these appear on the tree. The authors are very hopeful about the method; one, indeed, thinks it may enable most of the insect pests to be kept in check.

The bud rot of the cocoa-nut palm, described by J. B. Rorer in another paper, is an interesting example of a bacterial disease of plants. The disease has been much studied in the United States by Johnston (Bull. 228, U.S. Dept. of Agriculture), who comes to the remarkable conclusion that it is caused by *Bacillus coli*.

The United States Department of Agriculture and the entomological laboratories of the various colleges are, however, by far the most active investigators of plant diseases and insect pests. From the department itself issues a continuous stream of publications which we cannot pretend adequately to review. A. L. Quaintance has recently, in Circular 154, described the leaf blister mite (*Eriophyes pyri*, Pagenstecher), one of the smallest animals (they are not true insects) attacking horticultural crops. H. M. Russell, in Circular 151, deals with the greenhouse thrips (*Heliothrips haemorrhoidalis*, Bouché), which does considerable damage in attacking ornamental plants. E. S. Tucker, in Circular 152, describes the rice water-weevil (*Lissorhoptrus simplex*, Say), the larvæ of which feed on the roots of rice plants, while the adult weevils cause some harm by feeding on the rice leaves; altogether, this insect is regarded as the most serious enemy of rice in the southern States.

The Hawaiian Station has issued an account of Dr. Lyons's investigation of the curious sugarcane disease known as *iliau*, endemic in the island and not known elsewhere. He traces it to a fungus producing two types of fruiting bodies: a perfect form belonging to the genus Gnomonia and an imperfect form referable to the genus Melanconium; he proposes to call it *Gnomonia iliau*.

NOTES.

THE ninth International Congress of Zoology now sitting at Monaco, under the presidency of H.S.H. the Prince of Monaco, was opened on Tuesday at the Oceanographical Museum. There are seven sections and one subsection, as follows:—(1) Comparative Anatomy and Physiology; (2) Cytology and General Embryology; (3) Systematic Zoology; (4) General Zoology, Palæozoology, and Zoogeography; (5) Oceanographical Zoology and Plankton; (6) Applied Zoology, Parasitology, and Museums; (7) Zoological Nomenclature; subsection, Entomology. Every consideration for the convenience and comfort of members has been given. The sections meet in the Oceanographical Museum and Lyceum, close by. The common subject of conversation of members is concerning zoological nomenclature; we learn that there have been several preliminary unofficial meetings, and that proposals are forthcoming which will probably result in a decision satisfactory to zoologists in general. The Prince of Monaco opened the proceedings on Tuesday at 6 p.m., after which there was a reception in the museum. The programme shows that there are many and interesting communications. British membership on the opening day exceeds eighty out of a total of 723, the largest yet recorded for any international zoological congress. There is, however, not a proportionate number of British communications; those on the list on Monday were by Prof. Elliot Smith, of Manchester; Prof. J. Arthur Thomson, of Aberdeen; Dr. R. F. Scharff, of Dublin; Mr. E. Hall, of London; Dr. E. J. O. Hartert, of Tring; Dr. W. S. Bruce, of Edinburgh; Dr. M. Annandale and Dr. B. L. Chandhuri, of Calcutta; Dr. R. J. Anderson, of Galway; and Dr. Hornell, of Madras. Lord Walsingham will move an important resolution on zoological nomenclature, and among British members who are likely to take part in this discussion are Dr. S. F. Harmer and the Hon. Walter Rothschild.

EXCEPTIONALLY wild and stormy weather was experienced over the south of England on Saturday, March 22. A severe thunderstorm occurred in the southern counties in the afternoon, and this was followed by a brisk freshening of the wind, which developed during the evening to a violent gale. At 6 p.m. the centre of the storm was over Cornwall, and by 7 a.m. on Sunday morning it had reached Berwick, the disturbance progressing at the rate of more than forty miles an hour. A velocity of sixty-three miles an hour was attained by the wind at Kew at 8.50 p.m., and at 10.35 p.m. the hourly velocity was sixty-five miles an hour. On the south coast of England, where the greatest force of the gale was experienced, the wind attained the velocity of seventy to seventy-five miles an hour. The storm is probably the worst experienced for about the last eight years. Shortly before midnight the wind and sea carried away about 200 yards of the pier at Worthing. Much damage was wrought at Bungalow Town, near Shoreham, and also at Hythe, in Kent.

A SEVERE and destructive tornado occurred in the United States on the evening of Sunday, March 23. The greatest damage was done at Omaha, Nebraska, where about 150 people are said to have been killed and many more injured. The tornado swept the central States, and damage is reported from many places. Blocks of buildings were wrecked, and trains are reported to have been torn from the rails. Fire occurred in the wake of the tornado, and the torrential rain which followed the storm helped materially in extinguishing numerous conflagrations. The path traversed by the tornado is said to have been between 200 and 350 yards wide. At Omaha the storm is reported to have demolished one hundred and fifty houses and eleven churches. A report from Indianapolis states that owing to heavy rains following the tornado, the rivers in the State have overflowed their banks, and it is feared that there will be the worst floods for years. Several towns are reported as submerged.

ON Tuesday next, April 1, Dr. A. Smith Woodward will begin a course of two lectures at the Royal Institution on recent discoveries of early man, and on Thursday, April 3, Dr. E. Frankland Armstrong will begin a course of two lectures on (1) the bridge into life, (2) colour in flowers. The Friday evening discourse on April 4 will be delivered by Dr. J. J. Dobbie on the spectroscope in organic chemistry, and on April 11 by Mr. C. J. P. Cave, on the winds in the free air.

THE second circular of the International Geological Congress, 1913, has recently been issued. A change in the date of the sessions is notified: the meetings of the congress will begin at Toronto on Thursday, August 7, instead of August 21, as previously announced, and will terminate on August 14. The principal subject selected for discussion is "The Coal Resources of the World," and following the excellent precedent of the Stockholm congress, a large monograph on this subject will be prepared. The response from all over the world has been so cordial that the committee hopes to have the two quarto volumes and folio atlas ready in time for the meetings. The price will be twenty dollars the set. Other topics to be discussed are:—(2) Differentiation in igneous magmas; (3) the influence of depth on the character of metalliferous deposits; (4) the origin and extent of the pre-Cambrian sedimentaries; (5) the subdivisions, correlation, and terminology of the pre-Cambrian; (6) to what extent was the Ice age broken by interglacial periods?; (7) the physical and faunal characteristics of the Palæozoic seas, with reference to the value of the recurrence of seas in establishing geological systems. Authors of papers are specially invited to bring specimens to illustrate them, for which ample space will be provided, and the Department of Customs will give facilities for their entry into Canada duty free. A magnificent series of excursions has been planned, which will give an insight into the general geology, and particularly the glacial, pre-Cambrian, and economic geology of Canada. Twelve of these will take place before the congress; ten short excursions will be held during the congress and nine after. The first excursion starts from Montreal on July 13, and the longest of the post-congress excursions will reach Vancouver on September 22. Particulars may be obtained from the secretary of the congress, Victoria Museum, Ottawa, or from any geological society or survey.

MUCH attention is now being paid to the archæological remains in Jersey. In Bulletin No. 3 for 1912 of the Société d'Anthropologie de Paris, Dr. Deyrolle and Capt. Mauger describe the excavation of the tumulus and dolmen known as Teste-du-fief, in the northern part of the island. The owner has wisely decided that, after being opened, the monument is to be, so far as possible, preserved for examination by visitors, in its original condition. Within the dolmen the remains of a man buried beside his horse were discovered. Close to the right hand of the corpse was a small clay vessel, and close by a collection of horse teeth. Further information regarding this important discovery will be awaited with interest.

WE have received a copy of the first number of *Der Fischerbote* (Hamburg) for 1913, which contains much interesting information with regard to German fisheries, both in Europe and East Africa.

A VERY interesting new generic type of side-necked (pleurodiran) tortoise from the Keuper, in the neighbourhood of Stuttgart, is described by Prof. O. Fraas in *Jahresheft Ver. vat. Naturk. Württ.*, 1913, No. 80, under the name of *Proterochersis robusta*. Its peculiarity consists in the presence of two complete pairs of mesoplastral elements in the lower shell, which is believed to be a unique feature in the order. As a mesoplastron seems to be a primitive feature, its duplication appears to represent a still more archaic type. In vol. lx. of the "Palæontographica" (pp. 275–294) the same writer describes several new large labyrinthodonts from the Swabian Trias, one of which is referred to Cyclotosaurus, based on Meyer's *Capitosaurus robustus*, the genus also including the so-called *Capitosaurus stantonensis*, of the Warwickshire Keuper.

The American Naturalist for February contains four addresses on organic and inorganic adaptation in nature, delivered at the Symposium on this subject, at the meeting of the American Society of Naturalists at Cleveland on January 2, and a fifth on the fitness of the environment, being an inquiry into the biological significance of the properties. In the first Prof. Mayfield discusses adaptation through natural selection and orthogenesis, and in the second Prof. Livingston adaptation in the living and non-living, while in the third Prof. Parker considers adaptation in connection with animal reaction, and in the fourth Prof. Mathews reviews the subject from the point of view of the physiologist. As our readers may wonder what is meant by non-living adaptation, it may be mentioned that Prof. Livingston cites the case of pumice fragments in an inundation of the Colorado river. "Had it not been for the floating adaptation, these pumice-pebbles would have suffered temporary extinction in the form of submergence, and would not have been able . . . to gain dominance . . . in certain . . . beaches."

We have received a copy of the issue of February 7 of an apparently new journal, published by the California Associated Societies for the Conservation of Wild Life at San Francisco, under the title of *Western Wild Life Call*. California, it seems, is one of the States in which wild-killed game is still permitted to be sold, and it is one of the main objects of the new venture to obtain the total prohibition of this branch of trade. Among the species or races of animals in imminent danger of extermination in California, even if some of them have not been already killed off, are the wood-duck, the sharp-tailed duck, the prongbuck, two kinds of wapiti, the beaver, and the sea-elephant. The fate which has already overtaken the passenger-pigeon is now threatening the band-tailed pigeon (*Columba fasciata*) in California, a species which has somewhat similar habits, and is now being slaughtered in enormous numbers. So urgent is the case that total prohibition for a period of at least five years, and subsequently an annual close season, are deemed necessary.

Apropos of the correspondence which we have recently had on "retinal shadows," Mr. J. L. Herrick writes suggesting an explanation of the twinkling of distant lights. He has noticed at his home in Yonkers, New York, where there are many street lamps at different distances, that only the more distant lights twinkle, and he thinks that the occultation of the lights may be due to blood corpuscles in the retinal vessels. He applies the same explanation to the twinkling of stars. The latter phenomenon has received many explanations, physical and physiological. With regard to the latter, the subject was brought to the notice of the Physiological Society some years ago by Dr. J. S. Haldane, and was discussed by the members. Several suggestions were advanced, amongst others that it was due to the pulse waves in the retinal vessels. No adequate proof of any of the physiological theories was brought forward, and it is doubtful whether any theory yet adduced amounts to more than a plausible hypothesis.

A report of the experiments carried out for the Durham County Council, on the feeding of dairy cows, has been published in bulletin form (Offerton Bulletin No. 4), by Mr. F. P. Walker. The experiments include a comparison of soya cake with decorticated cotton cake, and Sudan dura with maize. In the former case soya cake gave, if anything, slightly better results than cotton cake, and in the latter dura was shown to be equal in value as a food to maize, and might profitably be adopted as a substitute in times of low prevailing prices. Other experiments with "crowdy" or watery foods as against concentrated foods tend to show that, on the whole, the quantity and quality of the milk are not affected. A possible action of "crowdy" rations in maintaining the flow of milk for a longer period than dry rations is indicated.

Dr. E. J. Russell and Mr. F. R. Petherbridge contribute a paper to the January number of the Journal of the Board of Agriculture on the sterilisation of the soil for glasshouse work. In continuation of earlier experiments on this interesting and complex problem, the authors have investigated the influence of heat and numerous antiseptics on the fertility of tomato-, cucumber-, and vine-sick soils, and have accumulated sufficient evidence to show that one or other of the various modes of treatment might be distinctly useful to practical growers. The effects of treatment may be attributed, in general, to the following changes:—(1) An increased bacterial activity with greater food production; (2) the reduction in numbers or death of disease organisms; (3) a modification of processes going on in the soil, so that certain unusual substances are present which produce special effects on the plant. These lead to early maturity and greater yields of tomatoes, early maturity in the case of cucumbers, and darker green and larger foliage and larger and brighter flowers with chrysanthemums. The best results were obtained in heated soils or those treated with formaldehyde, pyridine, or the higher bases, collidine, lutidine, &c.

Mr. R. Kirkpatrick, after zealous travel, considerable reading of recent geological literature, and painstaking observation, publishes a pamphlet entitled "The Nummulosphere" (Lamley and Co., London, 1913). In this he attempts to resuscitate Eozöon by finding structures of a discoidal nature common to it, to nummulites, and to almost every rock that he examines. The existence of these discs in nummulites is held to prove that all these other materials, including igneous lavas and granites, are of organic origin.

Students of the British Trias will find two papers of interest in the Proceedings of the Liverpool Geological Society, vol. xi., part iii. (1912). Rev. C. E. Spicer (p. 201) writes from personal observations of "Present Trias Conditions in Australia," and Sir T. H. Holland (p. 227) describes "The Origin of Desert Salt Deposits," laying special stress on the carrying of salt as fine dust by prevalent winds across the plains of north-west India. The "red marls" of the Trias are regarded (p. 245) as oxidised representatives of the black muds stained by ferrous sulphide found in modern salt-lakes in desert lands. Reasons are given (p. 246) for regarding the wind-borne salt as insufficient to affect Prof. J. Joly's use of the sodium in rivers and in the ocean as a measure of geological time.

FROM an educational point of view, no work issued by the United States Geological Survey has been more important than Professional Paper 71, by Mr. Bailey Willis, entitled "An Index to the Stratigraphy of North America" (1912). This memoir of 894 pages is accompanied by a coloured geological map of North America on the scale of 1 : 5,000,000, which includes, not only Mexico, the United States, and Canada, but Central America, the West Indies, Greenland, and Iceland as accessories. We should recommend the mounting of this map on large folding sheets, after the excellent manner of the Oxford wall maps, so that the whole or any of the four sections can be hung up as required. The paper is much more than an "index," since the formations are described in detail, and the views of various authors as to their modes of deposition are freely quoted. Canada is thus represented by her own authorities. The most striking features on the map are the immense areas covered by Tertiary volcanic rocks in the western Cordillera, and, in contrast, the severe pre-Cambrian region of the north-east, beyond the folded Mesozoic strata of the Rocky Mountains.

IN common with all other great earthquakes, the Messina earthquake of December 28, 1908, was followed by a large number of after-shocks. A record of the shocks felt at Messina was kept by Mr. G. Spadaro, then a student in the Nautical Institute in that city. During the last four days of 1908, eighty-seven shocks were felt, and during the following year 862. The majority of these shocks were, as usual, very slight, but four (in December, 1908, and January, 1909), were ruinous, and one (in July, 1909) almost disastrous. Dr. Agamennone points out (in the *Rivista di Astronomia*, &c., for last November) that the distribution of these shocks in time does not follow the simple law which, according to Prof. Omori, governs the decline in frequency of Japanese after-shocks, namely $y=k/(x+h)$, where y is the number of shocks in a given interval at time x, and h and k are constants, for the monthly number is greatest in March, 1909, and shows an increase in frequency towards the end of that year.

IN the *Revue générale des Sciences* for February 28 Prof. H. Devaux, of the University of Bordeaux, gives a *résumé* of his researches on the properties of thin layers of oil spread on the surfaces of water and mercury, a subject on which he has published a number of papers during the last ten years. It appears that the least thickness of oil which produces an appreciable effect on the surface tension of either water or mercury is much less than has been supposed. If a film of oil the thickness of which is known from its volume and area, is gradually thinned by increase of its area, the surface tension of the surface it covers has the value appropriate to oil until the thickness of the film, $1{\cdot}10\times 10^{-7}$ centimetre, is less than the mean diameter of an oil molecule, $1{\cdot}13\times 10^{-7}$ centimetre, as determined by M. Perrin's method. Below this thickness the film of oil does not affect the surface tension of either water or mercury.

THE February number of the Journal of the Institution of Electrical Engineers contains the lecture on permanent magnets which Prof. Silvanus P. Thompson delivered at the meeting of the institution at Glasgow last year. It occupies more than sixty pages, gives a complete account of present-day knowledge on the subject, and points out directions in which further research is necessary. The author shows that the most powerful and permanent magnets are made of steels with about 6 per cent. of tungsten and 0·5 per cent. of carbon, and have the ratio of length to breadth large. After forging at as low a temperature as possible the magnets should be heated to 900° C., cooled to 750° C., kept at that for a time, and then cooled off. Hardening is a repetition of this process down to 700° C., at which temperature the magnets are to be plunged into brine at 20° C. Maturing is done by boiling the magnets for ten or twelve hours. Magnetisation is effected by an electromagnet, and there is some advantage in a few reversals. For extreme constancy the magnetisation may be reduced by 5 or 10 per cent. by subjecting the magnets to demagnetising forces. The paper includes a bibliography which will prove of great use to future workers in this field.

MR. H. G. SEAGER, of Colwyn Bay, has devised an "automatic control" for aëroplanes, which appears well suited for the purpose of extricating an aviator from the difficulties in which he is placed by a sudden change of the conditions of either longitudinal or lateral equilibrium, such as that due to a gust of wind or a stoppage of the engines. It is perhaps not sufficiently realised that the initial effect of the latter cause is exactly represented by impressing on the machine a wrench equal and opposite to that of the propeller in steady motion, and if the propeller is much below the centre of gravity the result will be to turn the whole machine round until the air strikes on the top of the planes and sends the aëroplane to earth. Mr. Seager employs a pendulum, so arranged that any finite displacement exceeding a certain limit operates one or more air valves controlling pneumatic motors, and these displace the controls through a finite distance proportional to the number of valves operated on, this number depending again on the displacement of the pendulum. The arrangement has the obvious advantage that the pendulum oscillations can be damped out by friction, so that the apparatus can be adapted to an inherently stable aëroplane without interfering with its motion or control except in the case of large disturbances.

IN "Untersuchungen über die Gezeiten der feste Erde und die hypothetische Magmaschicht," a recent publication of the Geodetic Institute at Potsdam, Dr. W. Schweydar has made a very important contribution to the investigation into the nature of the earth's interior. His discussion of a long series of horizontal pendulum experiments throws considerable light on the outstanding difference between the coefficient of rigidity for the earth indicated by the Chandler motion of the pole and that given by tidal terms of long period. Consideration of the effects of ocean tides (discussed according to the dynamical theory) upon the semi-diurnal deformation of the solid earth gives the value for the rigidity of the earth as being two or three times that of steel. This value is of the same order as is required to account for the observed wandering of the pole, and also for the diurnal tide in the solid earth. Dr. Schweydar does not set much store by Dr. Hecker's differing results for the values of the east-west and the north-south elasticity, and he gives reasons for not accepting the explanations offered by Hecker and Lallemand. On one other debatable point of much importance Dr. Schweydar's results will be read with much interest. If the earth is to be regarded as consisting of an elastic core, a viscous layer, and a rind, then he decides that this viscous layer cannot be supposed to be of the fluidity of molten metal, but must be regarded as to all practical purposes solid. It need scarcely be stated here that this was the view reached on quite other grounds by the late Sir George Darwin.

In two papers published in the *Atti R. Accad. Lincei* (vol. xxxi., ii., pp. 740 and 803) Profs. R. Nasini and C. Porlezza describe the discovery for the first time of ozone in a natural water, and discuss the possible reasons for its presence therein. The water is that of Le Bagnore of Santa Fiora, in Monte Amiata, and the ozone is not a transitory but a permanent and normal constituent, imparting a distinct odour to the water, and being present to the extent of about 0·15 c.c. per litre. The water is not radio-active, and in default of other possible explanations, the view is put forward that the presence of ozone is due to autoxidation of ferrous bicarbonate, either *per se* or brought about by the action of the so-called iron-bacteria. The water of a spring at Bagnoli, Arcidosso, also in the Monte Amiata district, possesses similar properties, but in a minor degree. Both these waters have locally a high therapeutic reputation, and the question arises whether this is due to the ozone which they contain. Further investigations will be made to decide this and other points as to which there is still some uncertainty.

We have received a copy of the Transactions of the English Ceramic Society, part ii., session 1911–12, which, in addition to a number of papers of technical interest to potters, contains an account, which is of more general interest, of several of the principal pottery works on the Continent. In the summer of 1912 members of the Ceramic Society made a tour of inspection of ceramic works in Holland, Germany, and Belgium, and a report of the visit, admirably illustrated by photographs, covers forty pages of the Transactions. The descriptions given of the Royal Berlin Porcelain Factory at Charlottenburg, founded by Frederick the Great in 1763, and now carried on by the Prussian Government, with 660 workmen, and of the Royal Porcelain Factory at Meissen, founded in 1710, and now employing 800 hands, are of particular interest. The writer of the report expresses regret that no such institutions exist in England:—"In Germany, should a manufacturing potter have an idea which, through lack of capital or initiative, he is unable to work out to fruition, he at once has the assistance of the State pottery to test, and, if necessary, to evolve that idea, whereas in England brains can only be utilised apparently to the accompaniment of capital and risk."

A memorial portrait of the late Capt. Scott in uniform has been published by Messrs. Maull and Fox, the proprietors of the copyright in the only photographs of the explorer in full-dress uniform. The portrait, which is a photogravure, has been approved by Lady Scott, and the publishers have undertaken to contribute an agreed proportion of the profits of the sale of the portrait to the National Fund which is being raised. The price of the portrait is 5*s*. each, and copies can be obtained through the usual trade channels, or from Messrs. Maull and Fox, 187 Piccadilly, London, W., or Messrs. S. Hildesheimer and Co., Ltd., 96 Clerkenwell Road, London.

OUR ASTRONOMICAL COLUMN.

Spectrum of the Pleiades Nebula.—Bulletin No. 55 of the Lowell Observatory contains an interesting account of the results secured by Mr. Slipher in the photography of the spectrum of the nebula in the Pleiades. This nebula, as Mr. Slipher points out, would doubtless naturally be classed as a gaseous nebula since in its prominent characteristics it resembles more the great nebula in Orion, the typical gaseous nebula, than the more numerous class of spiral nebulæ. However, with the 24-in. refractor of the Lowell Observatory he made an exposure of twenty-one hours, obtaining, as he states, a perfectly legible record. This spectrum was continuous and crossed by strong hydrogen lines, $H\beta$, $H\gamma$, $H\delta$, $H\epsilon$, and $H\zeta$, and fainter helium lines, those at 4026, 4381, and 4472 (combined with 4481) being recognisable. No trace of any of the bright lines seen in the spectra of gaseous nebulæ was found, but the spectrum resembled a copy of the brighter stars of the Pleiades. The result suggested that the spectrum might be due to light from Merope scattered and reflected by the large objective. Exposures on the nebula of Orion and of a region near Sirius, led him to conclude that "the nebula shines by light, the spectrum of which is a true copy of that of the neighbouring star Merope and of the other bright stars of the Pleiades." It is suggested then that the nebula is disintegrated matter similar to what we are acquainted with in our solar system, as in the rings of Saturn, comets, &c., and that it shines by reflected light.

Chromospheric (Solar) Lines in the Spectrum of ϕ Persei.—An interesting paper by Mr. Paul W. Merril forms part of Lick Observatory Bulletin No. 224. In the course of a survey of Class B stars having bright hydrogen lines, the author has measured a number of lines, bright and dark, between $\lambda\lambda$4340 and 6515 in spectrograms of this star, and connects these lines with "chromospheric" lines taken from Young's lists in Frost-Scheiner's "Astronomical Spectroscopy." It is to be regretted that the author has not employed a more recent authority. However, he considers the presence of "chromospheric" radiations in the stellar spectrum established. The star does not duplicate the solar chromosphere, for it is stated that the phenomena presented by helium, magnesium, and sodium are anomalously at variance with the chromospheric spectrum. This paper extends and confirms, apparently unconsciously, the conclusion previously arrived at by Sir Norman Lockyer and

Mr. F. E. Baxandall (Proc. Roy. Soc., vol. lxxiv., pp. 548–550, 1905), when many lines in the emission spectrum of μ Centauri (also an Orion star with bright hydrogen lines) were found to agree in wave-length with enhanced iron lines.

WHAT BECOMES OF THE LIGHT OF THE STARS?—This question Prof. Very, of the Westwood Observatory, Mass., U.S.A., places before the readers of *The Popular Science Monthly,* and proceeds to give an interesting answer in an essay, highly speculative in character, developed in eighteen pages of the March number. The author ably marshals a useful body of evidence tending to establish that there is a general absorption of light by the ether. In this transformation of energy he sees the genesis of matter, and in meteorites he finds the "appointed instruments" whereby the nascent dust is collected "into the germs of future worlds." By atomic disintegration like that accompanying the degradation of radio-active elements the cosmogonic process is made reversible.

It may be mentioned that in reference to the "transient nebulosity," which appeared around Nova Persei, the author states: "It was an electric phenomenon, an exhibition of canal rays, or positive ions, on a grand scale," and that to explain the high temperature of the helium stars, he makes the hypothesis that they "contain an exceptional amount of peculiarly unstable elements."

PUBLICATIONS OF THE STRASSBURG UNIVERSITY OBSERVATORY.—The second part of vol. iv. of the *Annalen der Kaiserlichen Universitäts-Sternwarte in Strassburg*, published under the direction of Dr. Bauschinger, contains a large number of observations of double stars, planets, satellites, and nebulæ. The double stars were observed with a 49-cm. refractor by Dr. Wirtz between 1902 and 1910, and the results are compared with those obtained by other observers and with the ephemerides. The same observer is also responsible for the measures of the major planets and their discussion, in which are given the diameters and other measures, such as the dimensions of the Martian snowcaps, and the positions of the *streifen* on Jupiter; for the polar and equatorial diameters of the latter planet he finds the values $35{\cdot}986'' \pm 0{\cdot}028''$ and $38{\cdot}254'' \pm 0{\cdot}030''$ respectively.

TIDE TABLES.—From the Government Astronomer of New Zealand, Mr. C. E. Adams, we have received a report of the tide observations made at Auckland since December 1, 1908. These have now been harmonically analysed, and the results are given. There is also an interesting description of a new tide gauge designed by Mr. W. Ferguson, in which the recording pencil is moved by a clock and the paper on which the record is made is moved by the tide. The gauge has been running some months, and has given great satisfaction.

From the Government Printing Bureau at Ottawa we have received copies of the tide tables for the Canadian coast for 1913. The accompanying letterpress contains many interesting facts concerning the tides on the Pacific coast.

STARS WITH VARIABLE RADIAL VELOCITIES.—Mr. J. H. Moore, of the D. C. Mills Expedition's Observatory, Santiago, Chile, gives a list (L.O. Bulletin 224) of nine stars of about 5·0 magnitude, having variable radial velocities. In the same bulletin Prof. W. W. Campbell gives observations showing that the radial velocities of δ Andromedæ and μ Cephei respectively vary between $-1{\cdot}8$ km. and $-10{\cdot}8$ km., and $+15{\cdot}6$ and $+29{\cdot}4$. The latter also makes a correction regarding the radial velocity of i Capricorni. In L.O. Bulletin 97 this was stated to be variable. The removal of some errors of reduction leaves the velocity apparently constant at $+12$ km. per second.

THE TEACHING OF MATHEMATICS.[1]

THE papers enumerated below complete those written for the recent International Congress of Mathematicians. They deal with secondary schools, girls' school, preparatory schools, the training of teachers, technical institutes, and universities. Earlier papers in the same series were described in NATURE of March 14, 1912 (p. 44), and of May 23 (p. 305).

Secondary Schools.

No. 20 is a judicial discussion of "The Calculus as a School Subject." Mr. Jackson states impartially the questions involved, some of which can only be settled by greater experience than we now possess. Some questions are already settled, *e.g.* that if the calculus is to be introduced time must be found by a reduction in the drill which now prevails in algebra and trigonometry, by a frank recognition that tangents to curves and varying velocities involve the ideas of the calculus with some knowledge of the concrete ment that follows from this recognition. It is also desirable that the pupil should come to the study of the calculus, and by giving these subjects the treatmatters to which its methods are applicable. Mr. Jackson appears to be unaware that it is useless to point out an imperfection of proof to pupils who cannot discover the imperfection for themselves; but his pedagogy is in general so good that we feel sure he does himself injustice in this apparent ignorance.

Mr. Barnard (No. 22) frankly disapproves of the methods of teaching which have resulted from Prof. Perry's movement. He is all for thoroughness, and most of his article is taken up with a list of the blunders of text-books. We gather that he attributes these blunders to the new methods, a surprising view when we consider how few men educated in the new methods are old enough to write books.

Our conclusion is different. Writers of text-books are on the whole picked men, such as university professors and the ablest schoolmasters, and they are at present men trained on the old "thorough" methods; and if such blunders are possible for these picked men, it is indeed few of the schoolboys who are fit to profit by that training.

[1] The Teaching of Mathematics in the United Kingdom. Special Reports on Education Subjects.

No. 18. "Mathematics in the Education of Girls and Women." By Miss E. R. Gwatkin, Miss Sara A. Burstall and Mrs. Henry Sidgwick. Price 2½d.

No. 19. "Mathematics in Scotch Schools." By Prof. G. A. Gibson. Price 3d.

No. 20. "The Calculus as a School Subject." By Mr. C. S. Jackson. Price 1½d.

No. 21. "The Relation of Mathematics to Engineering at Cambridge." By Prof. B. Hopkinson. Price 1½d.

No. 22. "The Teaching of Algebra in Schools." By Mr. S. Barnard. Price 1½d.

No. 23. "Research and Advance Study as a Training for Mathematical Teachers." By Prof. G. H. Bryan. Price 1½d.

No. 24. "The Teaching of Mathematics in Evening Technical Institutions." By Dr. W. E. Sumpner. Price 1d.

No. 25. "The Undergraduate Course in Pass Mathematics, generally, and in relation to Economics and Statistics." By Prof. A. L. Bowley. Price 1½d.

No. 26. "The Preliminary Mathematical Training of Technical Students." By Mr. P. Abbott. Price 1½d.

No. 27. "The Training of Teachers of Mathematics." By Dr. T. P. Nunn. Price 1½d.

No. 28. "Recent Changes in the Mathematical Tripos at Cambridge." By Mr. A. Berry Price 1½d.

No. 29. "Mathematics in the Preparatory School." By Mr. E. Kitchener. Price 1½d.

No. 30. "Course in Mathematics for Municipal Secondary Schools." By Mr. L. M. Jones. Price 1½d.

No. 31. "Examinations for Mathematical Scholarships at Oxford and Cambridge." By Mr. A. E. Jolliffe and Mr. G. H. Hardy. Price 2d.

No. 32. "Parallel Straight Lines and the Method of Direction." By Mr. T. James Garstang. Price 1d.

No. 33. "Practical Mathematics at Public Schools." By Prof. H. H. Turner, Mr. R. C. Fawdry, Mr. A. W. Siddons, Mr. F. W. Sanderson, and Mr. G. M. Bell. Price 1d.

No. 34. "Mathematical Examinations at Oxford." By Mr. A. L. Dixon. Price 6d.

(London: Wyman and Sons, Lt Edinburgh: Oliver and Boyd; Dublin; E. Ponsonby, Ltd.)

Even Chrystal blundered; he is the only blunderer whose name is given by Mr. Barnard. Chrystal's was the last and greatest attempt to do for algebra what Euclid attempted for geometry, to build up the whole structure on a few axioms the truth of which was obvious. As the result of his attempt Chrystal learned (and was always ready to admit) how impossible of attainment this ideal is, a conclusion which is to-day becoming generally accepted. In the future, instead of trying to build mathematics up on axioms which are absolutely fundamental and by reasoning which only a genius is fit to grasp, we shall use as the foundation properties which are intelligible to every boy, we shall assume the truth of these whether obvious or not, and upon these we shall build the superstructure. The question of the soundness of the foundation is not a question for schoolboys, it is not even a question for the average university student, it is a question of metaphysics to be dealt with by the mathematical philosopher.

No. 30 is an account by Mr. L. M. Jones of the work in a municipal secondary school. The course is good, and ends with the calculus. It includes here and there an item on the value of which all would not agree, *e.g.* stocks and present value, solution of a quadratic by guessing factors, and the use of the straight line graph as introduction to graphs and the calculus. A sound opinion of Mr. Jones's, which one would like to see more widely adopted, is that the time spent in arithmetic on contracted methods is out of proportion to its value to the pupil, it being quicker and surer in most natural questions to use all the figures given than to contract.

In No. 32 Mr. Garstang attempts to pile up a load of wickedness on the Board of Education. He charges Circular 711 with loose reasoning in the matter of parallels, and quotes many authorities to show that a rigorous development cannot be based on the method of direction. But the withers of the Board are unwrung. It is the second and third stages of the Circular which deal with the systematic development of geometry; the first stage, containing the passage which displeases Mr. Garstang, is not concerned with rigorous development, but with the preliminary acquisition of the concepts of the subject.

At Oundle (paper No. 33) the data for practical mathematics are supplied from "the school shops, testing-rooms, and fields." This is admirable, and the boys show a keenness about the results because of their contact with reality, a keenness much greater than is aroused by questions which are only of academic interest to the pupils, however practical and important they may be for men or for other boys. A difficult problem for schools less fortunately situated than Oundle is the invention of laboratory questions which have real interest and importance for the boys to whom they are set.

No. 19 is a clear exposition by Prof. Gibson of mathematics in Scotch schools, which must have been of great value to members of the congress who were investigating such matters.

Preparatory Schools.

Paper No. 29 contains a pleasing sign of the times in the cooperation of public and preparatory schoolmasters. In former years a preparatory school had to prepare boys for a great variety of scholarship examinations, and a public school to continue the education of boys taught on a great variety of plans. To obviate the consequent difficulties, representatives of the Headmasters' Conference and the Association of Preparatory Schools have drawn up a syllabus for a boy's education in mathematics from nine to sixteen. This syllabus is now pretty widely used; it also bears witness to the advance made in recent years in the teaching of the subject.

Training of Teachers.

In No. 27 Dr. Nunn discusses the training of teachers of mathematics. Perhaps the most interesting part of his paper is his excellent syllabus of mathematical studies. The first part of the syllabus is compulsory, and includes numerical trigonometry and the ideas of the calculus. It is arranged with the object of giving a clear consciousness of mathematical conceptions. The logical proofs of these conceptions belongs to the second part, which is optional. The introduction to the calculus is made on historical lines, on which lines it is interesting to note that integration preceded differentiation.

One would like to see logarithms also follow the historical order, and introduced in Napier's way, without any consideration of indices. Dr. Nunn's method compels the treatment of negative and practical indices in part i., for which they are too difficult. But it is perhaps ungenerous to criticise a detail in a scheme drawn on such broad and statesmanlike lines.

Technical Institutions.

Nos. 24 and 26.—Most teachers of mathematics have their pupils at their mercy. In evening technical institutions we meet a new type, the youth who must be persuaded to come in. It is interesting and important that while mathematics treated in an abstract way deters him, the subject treated in connection with (and arising out of) concrete problems related to the boy's work not only persuades him to come in, but often gives him such an interest that he goes on with the abstract study.

Mr. Abbott also contributes the valuable suggestion that each locality should have an advisory committee composed of teachers of elementary schools, evening continuation schools, secondary schools, and technical schools, for the coordination of the work of these schools in regard to the preliminary training of technical students.

Dr. Sumpner and Mr. Abbott agree in the statement that students who come from elementary schools require much training in accuracy. There is clearly still room for reform in the mathematical teaching of these schools, when it is still necessary to recommend the abandonment of "discount, stocks and shares, H.C.F. and L.C.M., &c."

Universities.

In Nos. 21, 23, 25, 28, 31, 34, we have the views of the universities. Various changes are advocated, a reduction of the degree of analytical skill now required, an extension of the range of mathematical studies, closer connection with other subjects, more regard for after-careers, encouragement of original research. Recent reforms in school mathematics sometimes meet with approval, sometimes with disapproval. Oxford and Cambridge are working, in their examination regulations, towards a greater range and less analytical skill; Cambridge also towards meeting the needs of students of physics and engineering.

Prof. Bryan deplores the indifference of the practical man to the value of mathematics. Of this indifference there is no doubt, or of the fact that the practical man frequently meets a problem in which the mathematician could help him. The engineer has an outfit of mathematical tools sufficient for his ordinary needs, but at times he meets a problem for which his tools are useless. He may then spend thousands of pounds on the determination of some point which the mathematician could have settled for a five-pound note. Instead of collaborating, the practical man and the mathematician scorn one another with an equal scorn, and indulge in pin-pricks when they happen to meet. It seems to us that it is for the mathematicians, who are seeking admission into the practical man's sphere, to hold out the olive branch, to go to him and say:—"Yes, we have often given you reason for thinking us fools. But we think we can really help you this time. Only let us try; if we fail, you are no worse off than before."

Education of Girls and Women.

No. 18 contains three papers by Miss Gwatkin, Miss Burstall, and Mrs. Sidgwick. Miss Gwatkin gives an effective statement of the advantages to be gained by a girl from the study of mathematics. We fear, however, that these advantages can only be attained by exceptional girls, and that for the average girl it is an attempt to turn a good girl into an inferior boy, to implant masculine virtues in place of developing the feminine ones. We could wish that Miss Gwatkin had supplemented her statement by an estimate of the relative advantages to the girl of mathematics and of possible alternative studies.

In the same paper Miss Burstall shows, in a historical sketch, the chance wind by which mathematics was introduced as a necessary element in the secondary education of girls, and then proceeds to inquire how far it is appropriate there. She is in general agreement with the present tendency to give an occupational turn to school studies, and points out how little connection mathematics has with the life of the bulk of women.

Miss Burstall divides girls into three classes. At one end of the scale is the small number with a real taste for mathematics. For these the subject is an admirable training, provided the danger of "narrowness, hardness, ossification," is avoided by requiring a concurrent training in English literature or some other literary subject.

At the other end of the scale come a number of girls who cannot do mathematics at all, or only with an enormous expenditure of energy. The teaching of these she compares to the laboratory manufacture of diamonds, the cost of production being quite out of proportion to the value of the resulting article.

Between these two extremes lie the bulk of the girls. For them mathematical training has value, but the same attainment must not be expected of them as of boys. The importance of other subjects and the girl's total energy-supply have to be considered. They should study mathematics for two or three years and get what value they can from the study, but the assessment of results by examination should not be forced on every girl. In school-leaving and college-admission examinations the necessary guarantee of austere intellectual effort can be secured by making Latin or an appropriate treatment of Harmony alternative with mathematics.

In a short and eloquent paper on university mathematics for women, Mrs. Sidgwick maintains that "there is no need to consider the case of women separately from that of men," and that while "in planning a scheme of general education regard must be had to the probable future work of the learners, a subject which is studied not for its own sake, but because it is useful for something else, is almost always degraded in the process, and loses much of its educational value."

DAVID BEVERIDGE MAIR.

THE RUSTING OF IRON.[1]

IN the October issue of the Chemical Society's Journal, Mr. Bertram Lambert describes a second series of experiments on the rusting of iron. In these experiments it is shown by spectroscopic examination that carbon dioxide was actually present under the conditions used previously. Elaborate care was therefore taken to remove this, by heating as much as possible of the apparatus, whilst maintaining a high vacuum, and (during some of the successive heatings) cooling an attached tube in liquid air. The spectroscopic indications of carbon dioxide disappeared after the first of eight successive heatings, but no change was noticed in the readiness with which commercial iron rusted in the apparatus when purified oxygen and purified water were admitted. The author maintains, therefore, that these substances are capable of bringing about rusting in the absence of any trace of carbonic or other acid. The contrast between these results and those observed by Moody and by Friend is attributed to "passivity" induced in the metal in the one case by treatment with chromic acid (as suggested by Tilden), and in the other case by treatment with caustic soda (as suggested recently by Dunstan and Hill). This passivity must evidently be supposed to be permanent during many months of contact with air and water, but to be destroyed immediately by the merest trace of carbonic acid or by contact with glass.

An interesting account is given of the properties of pure iron as prepared by the methods previously described by the author, in which ferric nitrate is obtained so perfectly free from manganese that it no longer shows the violet colour which usually characterises the salt, and is then decomposed in iridium vessels, so as to avoid all risk of contamination with platinum. The metal so prepared is permanently resistant to rusting, even in contact with common air and common water. It does not dissolve in cold dilute sulphuric and nitric acids, but dissolves readily when the acids are heated. Hydrochloric acid dissolves the metal even in the cold. A similar contrast is noticed in the behaviour of the salts; the metal does not rust when exposed to air in presence of sodium, potassium, or ammonium sulphate or nitrate, but undergoes corrosion in a few hours when transferred to a normal solution of one of the chlorides. Again, pure iron will withstand the action of a saturated solution of copper sulphate or copper nitrate at the ordinary temperature for an indefinite time, without losing any of its lustre and without any perceptible trace of copper being deposited; but if a concentrated solution of copper chloride is used, the iron becomes coated with copper immediately it is put into the solution, and, within a few minutes, the iron all disappears, and only finely divided copper remains. The behaviour of the pure metal is here very similar to that of commercial aluminium.

The resistance of the purified metal to corrosion and to dissolution is probably due to the homogeneity of its surface, since if this is destroyed by pressing the metal with an agate pestle in an agate mortar the metal begins to corrode in less than an hour, rust being deposited on the unpressed parts of the metal whilst the pressed parts remain bright. In the same way copper is deposited on the iron if it is pressed in an agate mortar before being put into a solution of copper sulphate, or if it is pressed with a quartz rod while under the copper sulphate solution.

As a rule iron which will not rust will not deposit copper from the sulphate, and conversely; but in one

[1] See NATURE, 1911, vol. lxxxvi., p. 25.

case an interesting exception was observed. A piece of iron which had not rusted on long exposure to the action of air and water was placed in a strong solution of copper nitrate; after some time beautiful crystals of copper were deposited on parts of the iron, whilst other parts remained quite unaffected.

SOUTHERN HEMISPHERE SEASONAL CORRELATIONS.

THE first of a proposed series of articles on this important subject by Mr. R. C. Mossman, of the Argentine Meteorological Office, appears in *Symons's Meteorological Magazine* for February. Notwithstanding the great labour involved in this kind of research, it has received increasing attention from leading meteorologists during recent years. Mr. Mossman has collected a large mass of material relating to the climate of South America, which is now available for testing whether the sequences of weather in that continent "show as pronounced resemblances or contrasts, when compared with data from other regions, as do those in the northern hemisphere."

The inquiry now in question refers to the relation between the Nile flood and the winter rainfall of Santiago (Chile). The data used for the Nile floods are the percentage values for the years 1869–1906, published by Captain Lyons in "Rains of the Nile," 1906, and, for rainfall, the percentage values at Santiago for May-August of the same years. When plotted on a diagram, it is seen that, on the whole, there is a strongly pronounced opposition between the two sets of values. The author points out that the winter rainfall of Santiago, in common with other stations between 32° and 39° S., varies with the position of the South Pacific high-pressure area.

The Chilean Meteorological Office has recently supplied a complete set of instruments to Juan Fernandez, and the island is in radiographic communication with the mainland. This, with observations from a new station on Easter Island (27° S., 109° W.), should, Mr. Mossman thinks, afford useful information regarding the seasonal relations of the South Atlantic and South Pacific anticyclonic belts, and later on, when these data are compared with those at St. Helena, there is little doubt that the chain linking up the rainfall of Abyssinia with the Antarctic circulation will be complete. Captain Lyons has shown that the height of the Nile flood is dependent on the June to September rainfall in Abyssinia.

SOME METHODS OF MAGNIFYING FEEBLE SIGNALLING CURRENTS.[1]

TELEGRAPHY over long submarine cables is continually on the increase, and I think it may be brought forward as a fairly accurate statement that the number of messages sent doubles itself every ten years. It is therefore important that, besides the increase in the number of the cables laid down each year, means should be devised to increase the carrying power.

The instruments which I have invented and am about to describe were designed primarily for cable work, but they are equally applicable to recording many other kinds of signalling impulses.

For good reasons, recording by photographic means is objected to by nearly every telegraphist. If the photographic method were permissible, great advances in speed would be available, but it is important that the record should be of a simple, cheap, and immediate nature.

Lord Kelvin invented the siphon recorder in 1867—that is, about forty-five years ago; he designed it so carefully that no improvement in its sensitiveness has been brought about until now.

Short Siphon Recorder.

In siphon recorders of the moving-coil type what has to be done consists of—

(1) Overcoming the inertia of the coil and siphon.
(2) Overcoming the back E.M.F. of the coil.
(3) Overcoming the control of the suspensions.
(4) Overcoming the friction of air, suspensions, and inking.

As the siphon has to return to zero in a certain time after the current in the coil ceases, it is necessary for the coil and siphon to have a definite frequency of oscillation depending on the speed of the signals. For submarine telegraphy this frequency lies between about 3 and 10 per second, and is adjusted by varying the control on the coil. As the control necessary to give a certain natural period to the moving system is proportional to its moment of inertia, it follows that by reducing this inertia we reduce the forces required both to accelerate the coil and to overcome the control.

The ordinary siphon recorder employed is a siphon tube about $2\frac{1}{2}$ in. long and from 8 to 12 mils in

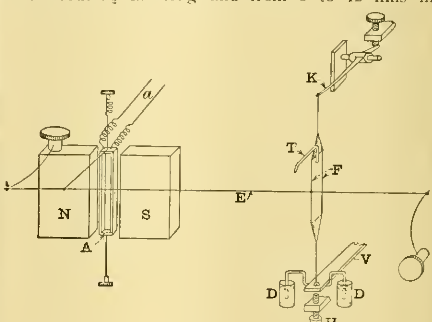

Fig. 1.

diameter. The moving coil consists of 500 turns of 2-mil wire at a mean radius of $\frac{3}{8}$ in. The coil and siphon are mounted on separate axes and are connected by silk fibres so that the angular movement of the siphon is about two to three times that of the coil. By reducing the length of the siphon to $\frac{1}{2}$ in. and substituting a narrower coil it is possible greatly to increase the sensitiveness of the recorder.

In order to make the inertia effects of the moving system a minimum, it is advisable to make them equal for the coil and the siphon. Even a narrow coil of 300 turns has about 100 times more inertia than the siphon, so that it is necessary to move the siphon through $\sqrt{100}$ times the angle moved by the coil.

By reducing the number of turns on the coil and increasing the field it is possible to reduce the natural period for a given sensitiveness and back E.M.F., but as the mass of the mountings and insulation of the coil only decrease slightly as the turns are reduced the gain is not very marked. In practice it is inadvisable to reduce the turns on the coil below 50 or 100 turns, as with lower values the power required to overcome the friction of the

[1] Discourse delivered at the Eighth Exhibition of Apparatus, held by the Physical Society on December 17, 1912, by Mr. S. G. Brown.

air and inking becomes too limited. This precludes the possibility of attaching the siphon directly to a coil of a few turns, and means of magnifying the motion of the coil and transmitting it to the siphon have to be used. In this instrument (Fig. 1) it is accomplished by means of a fine fibre, E, which is kept in tension by flat springs at each end. The fibre is attached to an arm carried by the moving coil A, and to a vertical fibre, F, on the siphon suspension.

The siphon is carried on an aluminium carrier to which a single central fibre is attached at the top and two parallel fibres, FF, 0·2 in. apart below. One leg of the siphon (Fig. 2) lies on the axis of the suspension and dips into a small opening in a pipe extending from the ink-pot. This arm goes in between the two vertical fibres, and as the opening in which the siphon dips is only a small one, the ink level remains practically constant, whether the reservoir is full or not. The siphon turns round on the axis in which the leg lies, and this makes the drag between the moving siphon and the ink very much less than if the siphon cut across the surface of the ink.

In order to produce an ink line on the paper without introducing friction, the siphon must not touch the paper even momentarily, and arrangements have been made to jerk the ink in fine drops on to the paper. To accomplish this the whole of the siphon suspension is vibrated rapidly up and down between the springs V and K by means of the spring V, which is attached to the vibrator. As the spring V is very weak in comparison with the reed, the vibrations of the latter are not affected by the movements of the spring. To impart a jerk to the siphon a stop, H, is fixed directly under the axis of suspensions, and two little dash-pots, DD, on either side prevent the spring bouncing on the stop.

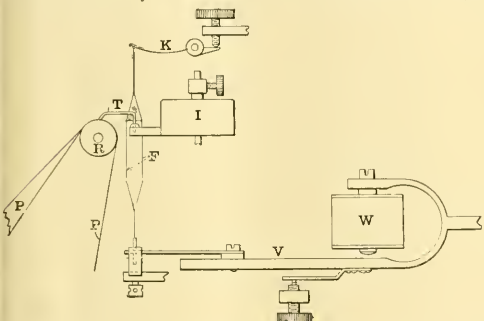

FIG. 2.

The working end of the siphon is ground flat, and an aniline dye with a small proportion of methylated spirit or ordinary red ink is used for recording on the paper. In this way a fine line of very closely spaced dots can be obtained without introducing any appreciable drag on the siphon.

For signalling purposes, the distortion due to the radius of the siphon being only $\frac{1}{2}$ in. is not at all troublesome as the velocity of the paper moving round the wheel R masks this.

When the instrument is adjusted to have a natural frequency of 10·5 per second, with a 300-ohm 300-turn coil, a current of 50 microamperes gives a full-sized signal corresponding to a deflection of 0·1 in. on the paper. Under these conditions the back E.M.F. of the coil is only about one-quarter to one-fifth of that of the ordinary recorder coil.

Trials with this instrument have shown an increase of speed of 30 per cent. on the largest Atlantic cables.

Thermoelectric Magnifying Relay.

In this instrument (Fig. 3) the power in the relay circuit is generated by means of five thermo-junctions at different temperatures. The heat is supplied by two little flames, CC, and a very light thermopile, B, is suspended so as to swing in and out of the flames, and is coupled to a moving coil through which the received currents pass.

The thermopiles consist of alternate junctions of platinum and platinum + 20 per cent. iridium, wires being used of 1 mil diameter. The joints are made by twisting the ends of the two wires together and holding the junctions in a Bunsen flame for a short time. In this way a perfectly good and permanent joint is ensured. The wires are melted on to a fine glass tube about 10 mils in diameter, and one connection is brought down inside the tube to the first junction and the other connection comes along the outside of the tube.

For moving the thermopile in the flames similar arrangements to those just described for the siphon recorder are employed. Under the saddle which carries the thermopile the two silk fibres are stretched, and on to one of these the cross fibre which transmits

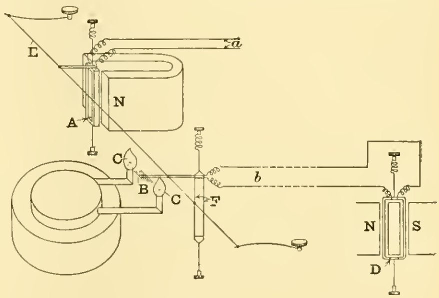

FIG. 3.

the movements of the coil to the thermopile is attached. The top and bottom suspensions are of fine phosphor bronze wire and serve as leading-in wires to the thermopile.

To supply the heat two little flames are fed by two or three strands of cotton wick with alcohol or methylated spirit. If the wick just protrudes above the opening a small steady flame is produced, and the lamp is provided with adjustments to vary the distance between the flames and the position of both flames relative to the thermopiles.

Instead of burning directly on the lamp wicks, a simple vapour burner can be fitted which will give good results even with very impure spirit. This consists of a brass cap which is kept hot by a copper wire attached to it at one end, and is heated at the other end by the flame. By altering the amount of wire in the flame the size can be varied.

An alternative arrangement which gives greater sensitiveness and enables heavier thermopiles to be used is to fix the thermopiles and vary the flames by means of a valve or shutter actuated by the coil movements.

As the thermopile current depends on the difference of temperature between the junctions a certain time is required to heat the wires. It is found that for cable work, where the frequency seldom exceeds

10 per second, the lag is inappreciable, but for considerably faster movements it becomes important.

In duplex working when the sending current has to be balanced so as not to affect the receiver, quick, "jarry" movements are very difficult to eliminate, but the lag in the thermo instrument reduces these movements very considerably and is a valuable property.

When the thermopile is in its central position and no current is flowing both junctions are at a dull red heat, and when fully deflected one junction becomes bright red and the opposite one is black or very faintly red. In intermediate positions the current generated by the thermopile is nearly proportional to the deflection.

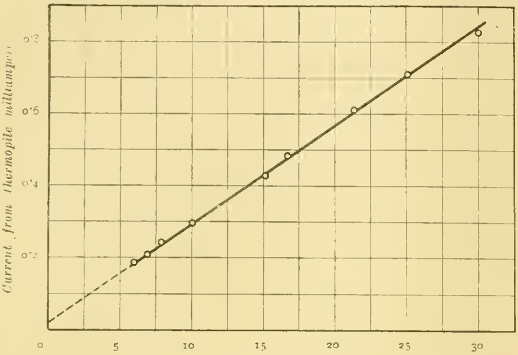

FIG. 4.

The curve (Fig. 4) was taken from a thermopile with seven junctions on each side. When the thermopile was deflected 0·075" the current it sent through a resistance of 42 ohms (equal to its own resistance) was 0·81 milliampere. With the natural period of the coil equal to 8·7 per second and a 480-ohm 480-turn coil, a current of 0·03 milliampere through the coil gave a current of 0·81 milliampere from the pile through an external resistance of 42 ohms. For slowly changing currents this corresponds to a magnification of power of about twenty-seven times, and, of course, this can be greatly increased by reducing the period of the coil. For quickly changing movements the power magnification is not so great, owing to the back E.M.F. of the coil.

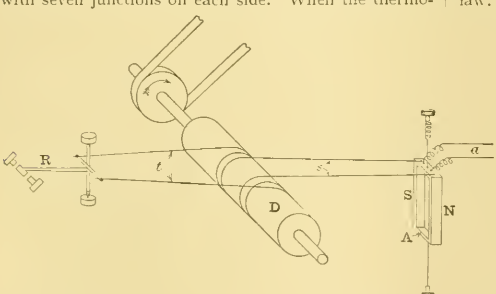

FIG. 5.

Trials of this instrument on an Atlantic cable have shown an increase in speed of about 40 per cent.

Mechanical Relay.

The instrument just described is a magnifying relay—that is to say, it multiplies the impulses received in exact proportion to their strength. This form of relay is quite distinct from an ordinary make-and-break relay, which delivers a constant current for any impulse over a certain strength. For very many purposes it is essential that received impulses should be magnified without altering their shape, and this can only be done by an instrument with a constant magnifying power.

That this is the case in the thermo relay is shown by the diagram (Fig. 4), where the current supplied to the coil and the current delivered by the thermo-junctions are plotted. Within the range of the instrument the points lie on a straight line and represent, in this case, a constant magnification in current of about twenty-seven times.

This property I will now illustrate in an entirely mechanical relay in which movements operated by very small forces are largely increased in strength without affecting their motion. The relay consists in principle of a rotating spindle around which are wound one or more turns of a flexible cord. The spindle is revolving in such a direction as to pull away from the magnified forces and towards the small forces that control the movement. Suppose a heavy weight has to be raised by a force of one-tenth of the amount, it will obviously be necessary to supply 90 per cent. additional energy, and this is supplied by the motor driving the spindle. The magnification of force and energy depends on the number of turns which the cord makes round the spindle and follows a compound interest law.

In the model shown it will be seen that a large magnification of power can be easily obtained by very simple means. Thus I can move this 14 lb. weight rapidly up and down by pulling upon this silk fibre.

Fig. 5 shows an application of the principle to cable work, in which the small forces operating the coil A are intensified sufficiently to work the coarse relay arm R. The spindle rotates away from the relay arm R and towards the coil, and produces a much greater tension in the fibres *t* than in *s*. When the coil swings on its axis the tension is increased in one of the fibres and diminished in the other, and a similar change in a magnified degree takes place in the fibres *t*.

By using means of this sort it is possible to work an ordinary siphon direct writer which normally requires some 3 milliamperes by a current of 10 microamperes.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A SUMMER School in Geography will be held at the University College of Wales, Aberystwyth, on July 28–August 16. Among the subjects included in the scheme of work are:—Human geography, Prof. H. J. Fleure; climatology and trade routes, W. E. Whitehouse; land forms and natural regions, E. S. Price; field classes and excursions.

The Department of Agriculture and Technical Instruction for Ireland has now published particulars of the summer courses for teachers it has arranged to hold in July and August next. With few exceptions the courses will be held in Dublin. In July teachers will have the opportunity of selecting their study from a wide variety of subjects of experimental science and technology. In August, practical mathematics, rural science, and a number of domestic arts will be taught. These courses are open only to persons who are over twenty years of age, and, except in the case of the courses in rural science (including school gardening) and drawing and modelling, only to teachers who are engaged (*a*) by local committees of technical instruction; or (*b*) in schools receiving grants either directly from the department or under the provisions of an approved local scheme of technical instruction. Application to attend the courses must be made before April 15.

The Education Committee of the West Riding County Council proposes to hold at the Training College, Bingley, in August next, a vacation course for teachers in secondary, technical, elementary, and other schools, beginning on August 5. The course will not be limited to West Riding teachers, but will be open to all on payment of the fees. The aim of the course is to stimulate teachers and to give them opportunities of studying new methods of teaching the various subjects rather than to give specific instruction in the subjects themselves. The subjects to be dealt with cover most branches of the curriculum, and include the following:—The teaching of practical arithmetic, Mr. J. R. Deeley; the teaching of handwork, Miss K. Steel; the teaching of domestic subjects, Miss G. E. Irons; physiology, Miss F. E. Relf; the teaching of experimental science, Prof. Arthur Smithells, F.R.S., and Mr. H. Calam; and nature-study, Miss Mary Simpson.

In his report for the academic year ending June 30 last, a copy of which has reached us, President Ira Remsen, of Johns Hopkins University, refers to the inauguration of a school of technology in the University. The creation of a new department of the University has been made possible by an Act of the Legislature of Maryland, in its session of 1912. The sum of 120,000*l*. was granted for the construction and equipment of buildings for a school of advanced technology. A further continuing annual grant of 10,000*l*. was also provided for maintenance. The provisions of the Act include the granting of 129 free scholarships to residents of the State. These scholarships are apportioned to the various legislative districts, to seven colleges in the State, and six may be awarded at large. Among the numerous public lectures given in the University during the year, we notice a course of eight on solar and terrestrial physics, by Prof. A. Schuster, one by Prof. W. Paszkowski, of the University of Berlin, on the organisation and work of that institution, and four by Prof. W. L. Johannsen, of the University of Copenhagen, on heredity and variation.

Lord Haldane gave an address on the problem of national education at the conference of the National Union of Teachers on Tuesday, March 25. He stated that he could not describe the details of the scheme proposed by the Government, but he could give his own views. In the course of his remarks he said:—"If we do not keep abreast in the training of the national mind with those other countries which are organising their education systems, and which in many respects are our superiors, it is inevitable that in these days, when science and knowledge are the conditions of all success, industrial and generally, we shall fall behind in the race. It is a question of national safety, and nothing else, with which we are dealing. I am sometimes very much concerned about our industries when I think of the backwardness of our educational system, but man does not live by bread alone, and we shall not get even a good technical education system unless we put it on a broad foundation of national education. The State has a deep and direct interest in seeing that its people are educated, just as it has in seeing that they are healthy. A national system must take cognisance of all the means by which education is provided in a country like this. The highest means, the lowest means, the university, the secondary and the elementary school—they must all be fitted into their place in one system. Ten years ago there were only six teaching universities, but since then five more have been established. Putting outside Oxford and Cambridge, the number of students working in the day time has doubled in the last ten years. The number of degrees obtained by students in England and Wales in 1911 is more than twice the number obtained in 1901. There are things which cannot be secured outside the atmosphere of the university. I can never admit that an external student is the same as an internal student. The internal student has matured his mind in the university atmosphere. The external student is working hard, but only for the external examination, and some people with much less aptitude than their neighbours in what is best in the realities of education have much greater aptitude in passing examinations. Therefore the external examination is not a real test of learning. The only real test of learning on which I should like to give a degree exclusively is the record of the student during his time at the university."

SOCIETIES AND ACADEMIES.

London.

Geological Society, March 5.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—S. S. **Buckman**: The "Kelloway Rock" of Scarborough. The author has studied the types of ammonites from the Kelloway Rock described by Leckenby, preserved in the Sedgwick Museum, Cambridge, and a series of Yorkshire Kelloway-Rock ammonites from the Museum of Practical Geology, London. He has grouped these ammonites according to their different matrices, and finds that they indicate several different zones. These zones he arranges in sequence, and suggests how they may be compared with the sections of Kelloway Rock of Scarborough given by Leckenby and by Fox-Strangways. The exact order of the zones is, in one or two cases, not considered to be proved, but the paper is offered with the idea of indicating where further work is required.—L. F. **Spath**: Jurassic ammonites from Jebel Zaghuan (Tunis). Jebel Zaghuan, the best-known and most conspicuous, though not the highest, mountain of the Tunisian Atlas, is built up largely of massive bluish-grey limestones of confused stratification which have been referred to the Middle Lias on the evidence of badly preserved belemnites and Terebratulæ, notably "*Pygope*" *aspasia*, *Columna* sp. Middle Liassic (Domerian) ammonites are now recorded for the first time. A new classification of the Domerian genera of the family Hildoceratidæ, to which the fossils from Jebel Zaghuan belong, is proposed. Moreover, the ammonites collected by the author afford sufficient evidence of the presence of the zone of *Reineckia anceps*, which occurs in Algeria, but had been supposed absent in Tunis, together with the other beds intervening between the Middle Lias and the Corallian.

CAMBRIDGE.

Philosophical Society, February 24.—Prof. Pope, vice-president, in the chair.—Prof. **Pope** and J. **Read**: The ten stereoisomeric tetrahydroquinaldinomethylene-camphors.—J. E. **Purvis** and A. E. **Rayner**: The chemical and bacterial condition of the Cam above and below the sewage effluent outfall. The river was investigated at various points extending from 100 ft. above the outfall and at 8 ft. from the outfall, and at $\frac{1}{4}$ of a mile, $\frac{1}{2}$ a mile, $\frac{3}{4}$ of a mile, $1\frac{1}{2}$ miles, 2 miles, $2\frac{1}{2}$ miles, 3 miles, and 4 miles below the outfall. Chemically, the river purifies itself moderately well from the contaminating effluent, for at about three-quarters of a mile below the effluent, the albuminoid ammonia and the oxygen absorbed figures were lower than at 100 ft. above the effluent outfall. Bacterially, the dangerous pollution, as indicated by *B. coli*, is well marked at between three and four miles below the outfall. The potential danger of such contamination is in the direction of cattle quenching their thirst, of bathers, .and of watercress.—F. E. E **Lamplough** and Miss A. M. **Hill**: Some experiments on the slow combustion of coal dust.—F. R. **Ennos**: The oxidation of ferrous salts. Air or oxygen was bubbled through ferrous salt solutions and the rate of oxidation measured by withdrawing portions at known intervals and titrating with $KMnO_4$ or $K_2Cr_2O_7$. For the chloride, sulphate, and acetate the rates are approximately as 1 : 10 : 100, the reaction in the case of the sulphate being proportional to the square of the ferrous salt concentration, and to the partial pressure of the oxygen. The oxidation seems to depend on the non-ionised part of the ferrous salt molecule.—W. H. **Mills** and Miss A. M. **Bain**: The optically active semicarbazone and benzoylphenylhydrazone of *cyclo*hexanone-4-carboxylic acid.—Dr. G. F. C. **Searle**: Experiments illustrating "flare spots" in photography. When light from a point S falls on a simple thin lens of focal length f, most of it passes through the lens and forms an image of S. But some of the light suffers two reflexions within the lens, and this light gives rise to a second image of S of small intensity, the corresponding focal length being $(\mu-1)f/(3\mu-1)$, where μ is the refractive index. This image is called a "flare spot." When two lenses are used there are six flare-spot images of any object formed by twice reflected rays and with t lenses there are $t\ (2t-1)$ such images.—J. G. M. **Dunlop**: Effect of heating paraformaldehyde with a trace of sulphuric acid. The author finds that in the preparation of α-trioxymethylene (Pratesi, Gaz., xiv., 139), by heating paraformaldehyde (trioxymethylene) with a trace of concentrated sulphuric acid in a sealed tube for some hours at 115° C., a considerable amount of the formaldehyde is converted to methyl formate.

PARIS.

Academy of Sciences, March 10.—M. P. Appell in the chair.—The president announced the death of M. Alfred Picard.—C. **Guichard**: A particular class of Moutard's equations.—Paul **Sabatier** and M. **Murat**: The direct hydrogenation of the hydrocinnamic esters; preparation of β-*cyclo*hexylpropionic acid. The reaction is effected with an active nickel at a temperature of 170° to 185°. Four esters have been prepared, and also β-*cyclo*hexylpropionamide.—R. **Lépine** and M. **Boulud**: The secretion of the two kidneys compared. In the healthy dog one of the ureters generally furnishes less urine than the other; there are also differences in the composition of the urine.—Henri **Renan**: Results of the discussion of observations made by MM. Delporte and Viennet, to determine by wireless telegraphy the difference of longitude between the Royal Belgian Observatory and the Observatory of Paris. The observations extended from May 1 to August 2, 1912, and comprised twenty determinations by wireless telegraphy and nineteen by ordinary telegraphy. The mean error of a single observation was ±0·0245 sec. by wireless and ±0·0285 sec. by ordinary telegraphy.—J. **Clairin**: The invariants of the characteristics of partial differential equations of the second order with two independent variables.—Vasilesco **Karpen**: The flight of birds called hovering flight. A calculation showing that hovering flight is possible when the mean geometric acceleration of the wind reaches 30 cm. to 50 cm. per second.—J. de **Boissoudy**: The law of radiation of a black body and the quanta theory.—Albert **Turpain**: Extra-sensitive relays for wireless telegraphy. The relay dscribed has a sensibility of the order 0·01 microampere.—C. **Tissot**: The reciprocal influence of two neighbouring antennæ.—F. **Bodroux**: Some liquid mixtures particularly suitable for the observation of Christiansen's phenomenon. A suitable mixture is made by pouring 15 gr. of ethyl acetate and 10 gr. of water into 50 gr. of saturated sodium chloride solution.—E. **Rothé**: The reception of radio-telegrams by multiple antennæ with or without contact with the soil.—A. **Guyau**: An interferential oscillograph. The apparatus figured was designed to register photographically oscillations of the magnitude of those of a telephone membrane.—B. **Szilard**: A spiral electrometer.—Ch. **Fabry** and H. **Buisson**: The absorption of ultra-violet light by ozone, and the extremity of the solar spectrum. The authors' results, taken with those of Cornu on absorption by the atmosphere, are in accord with the hypothesis of the absorption of the ultra-violet rays by ozone in the atmosphere.—B. **Bianu**: The secondary radiation produced by the α rays.—Camille **Matignon**: Chemical equilibrium in the action of hydrochloric acid gas on zinc sulphate.—E. **Rengade** and N. **Costeanu**: The anhydrous monosulphides of the alkaline metals. The pure sulphides, Na_2S, K_2S, and Rb_2S, were obtained by allowing the vapour of sulphur to react upon the metal, with special precautions against the access of air. These sulphides are very easily oxidised; it is sufficient to touch one at a point with a hot glass rod for the mass to become incandescent and burn like tinder.—E. E. **Blaise**: The migration of chlorine in the chloroketones.—A. **Lassieur**: The catalytic hydrogenation of acetone. At temperatures between 200° and 300° C. hydrogen in presence of reduced nickel gives with acetone neither isopropyl alcohol nor pinacone, but methyl*iso*butylketone in large quantities, smaller amounts of valerone and other higher condensation products.—P. **Lebeau** and A. **Damiens**: The composition of coal gas. An application of the general method of analysing complex mixtures involving the use of very low temperatures recently described by the authors. The presence of ethane, propane, and butane was proved with certainty.—L. **Ravaz** and G. **Verge**: The germination of the winter spores of *Plasmopara viticola*.—L. **Blaringhem**: The phenomena of xenia in wheat.—C. L. **Gatin** and C. M. **Bret**: The varieties of *Elais guineensis*, of the Ivory Coast, and their parthenocarpic fruits.—Paul **Becquerel**: Vascular ontogeny of the plantule of the lupin and its consequences for certain theories of the classical anatomy.—Anna **Drzewina** and George **Bohn**: Anoxybiose and chemical polarity. An account of the effects of deprivation of oxygen on various species of invertebrates.—E. **Bataillon**: Demonstration of inoculation superposed on puncture in traumatic parthenogenesis.—Mlle. **Chevroton** and M. **Fauré-Fremiet**: A kinematographic study of the cytoplasmic phenomena of the division of the egg of Ascaris.—G. J. **Painvin**: The siphon of the Spirulæ.—H. **Vincent**: The action of polyvalent antityphoid vaccine in subjects in the incubation stage of typhoid fever or infected in the course of immunisation. From experience gained in the typhoid epidemics cited it would appear that with this vaccine there is no negative phase, and there is no danger in vaccinating during epidemics.—MM. **Desgrez** and **Dorléans**: The influence of the amino group on the arterial pressure. A lowering of the blood pressure is produced by minimal doses of certain amino compounds, but an increase in the amount injected produces ultimately an increase in the arterial pressure.—J. **Houdas**: The presence of choline or allied bases in the saliva of the horse.—Em. **Bourquelot** and M. **Bridel**: The synthesis of the glucosides of alcohols with the aid of emulsin. β-Phenylethylglucoside and β-cinnamylglucoside.—Ph. **Négris**: The age of the cristallophyllian series of the Cyclades and the date of the foldings which have affected it.—F. **Dienert**: Study of the temperatures of subterranean water for public supply.—V. **Crémieu**: Seismographs giving directly the three components of an earthquake and slow variations from the vertical.

March 17.—M. P. Appell in the chair.—E. H. **Amagat**: Saturation curves and the law of corresponding states. The author concludes that the law of corresponding states is more rigorous than is usually admitted, and gives reasons for supposing that deviations from the law are probably due to experimental error.—A. **Müntz** and E. **Lainé**: The materials transported by the watercourses of the Alps and Pyrenees. The utilisation of mountain streams either for power or irrigation purposes requires an approximate knowledge of the amount of solid material brought down, as this material would tend to fill up more or less rapidly any storage reservoirs which might be constructed. A preliminary study has been made on eighteen rivers, and it has been found that the amounts of solid material brought down by alpine streams are so great that the construction of storage reservoirs will require very careful choice; the streams from the Pyrenees are much less troublesome in this respect.—M. **Gouy**: The theory of the gaseous photosphere.—D. **Eginitis**: The opacity of the sky and weakening of the solar radiation observed during the year 1912. The heliograph at Athens shows a progressive weakening in the solar radiation commencing April 7, 1912.—M. **Luizet** and J. **Guillaume**: Observation of the occultation of the Pleiades by the moon made on March 13, 1913, at the Observatory of Lyons. —Léon **Antonne**: Hypohermitian matrices.—Ch. **Muntz**: The solution of secular equations and integral equations.—Georges **Rémoundos**: Families of algebroid functions.—Farid Boulad **Bey**: The disjunction of the variables in equations representable by nomograms.—Th. De **Donder**: Hilbert's theorem of independence.—Carlo **Bourlet**: Apparatus for measuring the vibrations of solid bodies in motion. A description of an instrument for measuring the vibration of the wing of an aëroplane, based on the use of two manometric capsules.—Emile **Jouguet**: The propagation of deflagrations in gaseous mixtures.—Edouard **Guillaume**: The extension of the mechanical equations of Appell to the physics of continuous media. Application to the theory of electrons.—Kr. **Birkeland**: Hertzian oscillations produced by intermittent discharges starting from isolated spots of a kathode in a Crookes's tube. —Henri **Bénard**: The prismatic cleavage due to cellular vortices (starch, basalts, &c.).—Jean **Bielecki** and Victor **Henri**: The quantitative study of the absorption of the ultra-violet rays by acetone. In alcoholic solution and in the liquid state acetone possesses a single band in the ultra-violet; the absorption curve can be exactly represented by the formula of Ketteler, Helmholtz, Reiff, and Drude.—Mlle. E. **Feytis**: The magnetic properties of some solid hydrates of copper and chromium.—Daniel **Berthelot** and Henry **Gaudechon**: The decomposition of gaseous compounds by light. Hydrochloric acid is dissociated by the extreme ultra-violet, $\lambda < 0{\cdot}2\mu$. Hydrobromic acid is more readily decomposed, and, in presence of mercury, the decomposition after eight hours is complete. Water vapour is decomposed by rays $\lambda < 0{\cdot}2\mu$ to the extent of one-thousandth. Hydrogen sulphide and selenide are readily split up under the same conditions. —Mme. N. **Demassieux**: Study of the equilibrium between lead chloride and ammonium chloride in aqueous solution.—René **Dubrisay**: A new method of physico-chemical volumetric analysis.—A. **Wahl** and P. **Bagard**: Syntheses in the indigo series.—A. **Seyewetz**: The action of hydrochloric acid upon quinone sulphonic acid.—G. **Petit** and R. **Ancelin**: The influence of radio-activity upon germination. The experiments prove the stimulating influence of weak radio-activities on the plant cell.—L. **Moreau** and E. **Vinet**: The comparative effects of arsenic and lead in treatment of vines for the larvæ of Cochylis. Lead arsenate proved to be the most efficacious form of applying arsenic for the destruction of the larvæ of Cochylis.—D. **Keilin**: An intracellular fibrillary formation in the tunic of the salivary gland in the larva of Syrphinæ.—Raphael **Dubois**: The treatment of tuberculosis by marine micro-organisms. Cultures of a Micrococcus obtained from the pearl sac of *Pinna nobilis* or *P. squammata* were used to inoculate tuberculous guinea-pigs; eleven out of twelve survived.—Henri **Stassano**: The mode of action of the anti-coagulating substance of the plasma of propeptone.—Mlle. C. **Robert**: The antitoxin behaviour of calcium in the case of some nutritive salts in the culture of the pea and lupin in liquid media.—W. **Kopaczewski**: The dialysis of maltase.—M. **Deprat**: The Triassic strata in the region of the middle Black River (Tonkin).

CALCUTTA.

Asiatic Society of Bengal, February 5.—Dr. Malcolm **Burr**: Indian Dermaptera collected by Dr. A. D. Imms. A number of new localities for known species of earwigs are put on record and one new species is described.—Dr. W. A. K. **Christie**: The composition of the water of the Lake of Tiberias. The water of the Sea of Galilee is shown to differ widely from that of almost all lakes with an outlet, and to approximate more in composition to that accumulated in closed basins. The difference is due to the peculiar nature of the soluble constituents of the rocks of the neighbourhood, as shown by analyses of spring waters near the town of Tiberias.—Major J. **Stephenson**: Aquatic Oligochæta of the Lake of Tiberias. The collection obtained by Dr. Annandale from the edge of the Lake of Tiberias includes specimens of a number of species, representing several different families; but the majority are immature, and only two can be identified—a Helodrilus described as new, and *Criodrilus lacuum*, a common European species.

BOOKS RECEIVED.

Mysore Geological Department. Report of the Chief Inspector of Mines for the Year 1911–12, with Statistics for the Calendar Year 1911. Pp. 45+12 tables+81. (Bangalore: Government Press.) 2 rupees.

The Coleoptera of the British Islands. By Dr. W. W. Fowler and H. H. J. Donisthorpe. Vol vi. (Supplement.) Pp. xiii+351+3 plates. (London: Lovell Reeve and Co., Ltd.) 18s. net.

Handbuch der Morphologie der wirbellosen Tiere. Edited by A. Lang. Band 3, Lief. 1. Band 4, Lief. 2. (Jena: G. Fischer.) 5 marks each Lief.

Bericht über die Tätigkeit des Königlich Preussischen Meteorologischen Instituts im Jahre 1912. Pp. 53+172+3 plates. (Berlin: Behrend and Co.) 6 marks.

Bibliotheca Geographica. Band xvii. Jahrgang 1908. Pp. xvi+533. (Berlin: W. H. Kühl.)

Iowa Geological Survey. Vol. xxi. Annual Reports, 1910 and 1911, with Accompanying Papers Prepared in Cooperation with the U.S. Geological Survey. Pp. xvi+1214+xviii plates. (Des Moines: Iowa Geological Survey.)

Traité Complet d'Analyse chimique appliquée aux Essais Industriels. By Profs. J. Post and B. Neumann. Deux. Edition Française, Entièrement Refondue. By G. Chenu and M. Pellet. Tome Troisième. Second Fasc. Pp. 465–902+v. (Paris: A. Hermann et Fils.) 15 francs.

Traité de Chimie Minérale. By H. Erdmann. Translated by Prof. A. Corvisy. Tome Premier. Pp. iv+559. (Paris: A. Hermann et Fils.) 12 francs.

A New Philosophy: Henri Bergson. By E. Le Roy. Translated by V. Benson. Pp. x+235. (London: Williams and Norgate.) 5*s*. net.

Myths of the Modocs. By J. Curtin. Pp. xii+389. (London: Sampson Low and Co., Ltd.) 12*s*. 6*d*. net.

In the Lap of the Lammermoors. By W. M'Conachie. Pp. xii+315. (Edinburgh and London: W. Blackwood and Sons.) 5*s*. net.

The Belief in Immortality and the Worship of the Dead. By Prof. J. G. Frazer. Vol. i. Pp. xxi+495. (London: Macmillan and Co., Ltd.) 10*s*. net.

Das Miocän von Eggenburg. By Dr. F. X. Schaffer. (Abhandlungen der K.K. Geologischen Reichsanstalt. Band xxii. Heft 2.) Pp. 129–193+12 plates. (Vienna: k.k. Geologischen Reichsanstalt.) 16 kronen.

The Deciding Voice of the Monuments in Biblical Criticism. By Dr. M. G. Kyle. Pp. xviii+320. (London: S.P.C.K.) 4*s*. net.

Aus Süd-Brasilien. By Dr. W. Breitenbach. Pp. xvi+251. (Brackwede i.W.: Dr. W. Breitenbach.) 3 marks.

The Chemistry of Dyeing. By Dr. J. K. Wood. Pp. vii+80. (London: Gurney and Jackson.) 1*s*. 6*d*. net.

Volume and Surface Integrals Used in Physics. By J. G. Leathem. Second edition. Pp. iv+73. (Cambridge University Press.) 2*s*. 6*d*. net.

Machine Construction and Drawing. By A. E. Ingham. Pp. xii+143. (London: G. Routledge and Sons, Ltd.) 1*s*. 6*d*. net.

Vorträge über Deszendenztheorie gehalten an der Universität zu Freiburg im Breisgau. By Prof. A. Weissmann. Dritte Auflage. Erster Band und Zweiter Band. Pp. xiv+342+vii+354+3 plates. (Jena: G. Fischer.) 13 marks.

Die Palaeobotanische Literatur. Edited by W. J. Longmans. Dritter Band. Die Erscheinungen der Jahre 1910 und 1911 und Nachträge für 1909. Pp. 569. (Jena: G. Fischer.) 26 marks.

DIARY OF SOCIETIES.

THURSDAY, March 27.

Concrete Institute, at 7.30.—Props and Beams in Mines: Prof. S. M. Dixon.

MONDAY, March 31.

Institute of Actuaries, at 5.—The Estimated Age Distribution of the Indian Population, as Recorded at the Census of 1911, and the Estimated Rates of Mortality, Deduced from a Comparison of the Census Returns for 1901 and 1911: T. G. Ackland.

TUESDAY, April 1.

Royal Institution, at 3.—Recent Discoveries of Early Man: Dr. A. S. Woodward.

Röntgen Society, at 8.15.—The Physiological Principles of Internal Radium Therapy: Prof. Saubermann, Berlin.—The Radiographic Episcope, a New Instrument for the Utilisation of the Single X-Ray Print: Dr. Cotton.

Institution of Civil Engineers, at 8.—The Yield of Various Catchment-Areas in Scotland: W. C. Reid.—Measurement of the Flow of the River Derwent, Derbyshire: E. Sandeman.

WEDNESDAY, April 2.

Entomological Society, at 8.

Society of Public Analysts, at 8.—The Moisture in some English, Colonial and Foreign Butters during 1910–1912, with a Note on the Mitchell-Walker Moisture Test: L. Gowing-Scopes.—Egyptian Butter and Semna: S. H. Trimen.—A Simple Test for Differentiating between Cocoa-Butter and "Green" Butters: C. Revis and E. Richards Bolton.—The Correct Way to Use Glycerine-Jelly in Mounting Microscopical Objects: L. W. Stansell.—A New Apparatus for Maintaining Constant Temperatures: F. H. Dupré and P. V. Dupré.

British Astronomical Association, at 5.

THURSDAY, April 3.

Royal Institution, at 3.—The Bridge into Life: Dr. E. Frankland Armstrong.

Linnean Society, at 8.—Some Forms of *Alchemilla vulgaris*: C. E. Salmon.—Report on H.M.S. *Sealark*, Calcarea Prof. A. Dendy.—*Embia major*, sp. nov., from the Himalayas: Prof. A. D. Imms.—A Free-swimming Nauplioid Stage in Palinuris: Dr. J. D. F. Gilchrist.—The Classification of the Order Symphyla: R. S. Bagnall.

Institution of Mechanical Engineers, at 8.—*Further Discussion*: Some Effects of Superheating and Feed-water Heating on Locomotive Working: F. H. Trevithick and P. J. Cowan.

FRIDAY, April 4.

Royal Institution, at 9.—The Spectroscope in Organic Chemistry: Dr. J. J. Dobbie.

Geologists' Association, at 8.—The Geology of the Nottingham District: B. Smith.

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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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DESERT LAND FORMS.

Das Gesetz der Wüstenbildung in Gegenwart und Vorzeit. By Prof. Johannes Walther. Zweite, neubearbeitete Auflage. Pp. xv+342; illustrated. (Leipzig: Quelle and Meyer, 1912.) Price 12 marks.

DESERT regions have received much attention during recent years, and in this volume Prof. Walther presents a very instructive geographical study of the north-eastern part of Africa. This is something more than a new edition of that which he published under the same title in 1900, for the fourteen essays on different aspects of desert conditions which there appeared have been recast and rearranged under the headings of the character of the desert, erosion in the desert, and deposition in the desert, together with a fourth chapter in which the evidence for the identification of desert areas in the past history of the earth is assembled. A visit to Egypt and the north Sudan in 1911 provided the opportunity for extending and supplementing his earlier observations, and recent railway extensions enabled him in the time at his disposal to visit the oasis of Kharga, Khartum, and to cross the Red Sea hills between the Sudan plains and Suakin. The result is a very interesting and instructive work dealing primarily with a part of the north African desert, but introducing many examples from other arid regions of the world.

In treating of precipitation in the desert the author has, we think, in following Sickenberger, gone somewhat too far in saying that dew is entirely absent in the interior of the desert. The absolute humidity is usually not very low, and on cold clear nights dew is not infrequently formed. Stress is rightly laid on the action of rainfall in areas which are fairly described in general terms as rainless, for such falls of rain are not at all uncommonly reported when a wide region is considered, though each fall may be extremely local in extent. The rock tombs on the west of the Nile at Thebes are quoted as providing evidence that the water from the Nile does not there percolate to any distance from its bed. Here the river flows in its alluvial flood plain for the most part. Grabham has shown that the varying levels of the Blue Nile are to be traced so far as 900 metres from its banks in the Sudan, and it appears from discharges which have been measured that a considerable loss from the river takes place, over and above that due to evaporation, in such long reaches as that near Dongola, where the river flows for long distances in the Nubian sandstone.

An especially interesting part of this book deals with the Sudan desert and the "half-desert" on the northern fringe of the monsoon rains, where the extreme aridity of the Nubian and Libyan deserts gives place to less inhospitable conditions and vegetation can develop to a limited extent. The Red Sea hills furnish most instructive instances of this, and of the erosion characteristic of such regions. Many interesting examples of erosion and of deposition are described, and are particularly well illustrated by characteristic and well-chosen photographs. Doubtless because the parts of the country which the author visited do not exhibit good examples of the process, there is not much reference to the filling of wide valleys and depressions with rock waste swept down from the higher levels which may be seen so finely represented further north than the Berber-Suakin route which was followed, in the valleys of the complex of crystalline ranges which form the western shore of the Red Sea. This greatly enlarged edition of a work already well known will be most acceptable to both geographers and geologists. H. G. L.

THE PROPERTIES OF STEAM.

The New Steam Tables: together with their Derivation and Application. By Prof. C. A. M. Smith and A. G. Warren. With an introduction by Sir J. Alfred Ewing, K.C.B., F.R.S. Pp. xii+101. (London: Constable and Co., Ltd., 1913.) Price 4*s.* net.

PROF. CALLENDAR, in his Royal Society paper of 1900, suggested the use as the characteristic for steam of $v-b=R\theta/p-C\theta^{-n}=V-c$, say. This is suggested by the Joule-Thomson equation for gases, where $n=2$, and by Grindley's result for steam, in which $n=3{\cdot}8$. Only a man of Prof. Callendar's reputation could have received attention, for he gave rather fanciful reasons for taking $n=3{\cdot}5$, and for his values of the specific heats when p is very small. Again, it is probably quite untrue that c is a function of temperature only. Nevertheless, when steam tables are calculated by means of the above characteristic, the constants b, C, and n (and, indeed, R also) can be given such values as make the calculations agree with what Prof. Callendar regards as the best experimental results, and he recommended in 1900 that tables calculated from his formulæ should be substituted for the usual tables as given by Regnault and modified by Griffiths and others. The numbers of the new tables are consistent with each other, and this is a great advantage, because we generally need differences of total heats, for example, rather than their absolute amounts.

Prof. Mollier, of Dresden, in 1906 published tables and sheets of curves calculated on Callendar's methods, and these were published by Sir J. A. Ewing in the third edition of his book on the steam engine in 1910. Prof. Smith and Mr. Warren have recalculated all the numbers (with slight divergences from Mollier's results), using values of the constants which seem to them best, and they reproduce Prof. Mollier's curves showing total heat on an entropy base. They give both Centigrade and Fahrenheit tables. If Prof. Callendar's methods are right there can be no doubt that Prof. Smith and Mr. Warren have done a great service to steam engineers. They nowhere state what is their unit of heat, but it is probably that which agrees with $J = 1399$ or 1400. This will not agree with their figures for the total heat of water. It is also a pity that they do not give the actual experimental results on which their calculations are based; no doubt great weight is given to the Joly-Callendar value of L at 100° C., and to Callendar's specific heat as well as the Munich results.

Fair agreement of the steam tables with measured values of L, &c., is no proof that Prof. Callendar's method is legitimate, because good agreement may be effected even if we take c to be a constant, b being the volume of water, or, indeed, if we take steam to be a perfect gas. The only real test would be that the calculated specific heat for various temperatures and pressures should agree with measured values. This test cannot be applied until we have better experimental results. J. P.

PRACTICAL AGRICULTURAL CHEMISTRY.

Practical Agricultural Chemistry. By Prof. S. J. M. Auld and D. R. Edwardes-Ker. Pp. xxiv+243. (London: John Murray, 1913.) Price 5s. net.

UNTIL recently the teacher of agricultural subjects in this country suffered from the disadvantage (or advantage if one looks upon it in that light) that very few textbooks were available to help him in his teaching. The result was that each man had to devise his own course and modify it as time went on and experience accumulated. There is a tendency at the present time for teachers to put their courses on record, and the plan has much to commend it.

The latest scheme thus printed is the laboratory course for students of agricultural chemistry used by Dr. Auld and Mr. Edwardes-Ker. It opens with a good section on plant-life which is distinctly fuller than usual, including experiments with certain plant constituents not commonly studied in other laboratories. The teacher will find material here that may be new to him and that he may advantageously embody in his own course. The section on soils presents few novel features; indeed, there are some directions in which marked improvements might be made. Above all things, it is necessary to be clear in dealing with the agricultural student. But we find that on p. 86 the "clay" in soil is estimated by a method which will bring out particles less than 0·002 mm. in diameter; on p. 90 by a method which brings out particles less than 0·01 mm. in diameter; while on p. 62 a scheme of classification of soils is given which supposes that "clay" is something altogether different from either. Yet there is no hint that the word is being used in three different senses. The precise definition of clay must be a matter of convention; it is much better for the young student to begin on the British convention and defer the detailed study of other conventions until he is more advanced in the subject.

We should like also to have seen some of the newer and improved methods of analysis brought in. The Neubauer method of examining soil extracts, and the titration method for determining phosphates, are much simpler and quicker than those given, while the perchlorate method of estimating potassium is at least as accurate as, and much cheaper and more convenient than, the costly and cumbersome platinum method. These, however, are essentially matters of detail, and as the authors have shown courage in introducing some new matter in their course, it may be hoped that they will have the further courage to test the newer methods that are now available and adopt them in their teaching. E. J. R.

SCIENTIFIC EGYPTOLOGY.

(1) *Service des Antiquités de l'Egypte. Catalogue Général des Antiquités Egyptiennes du Musée du Caire.* Nos. 61,051–61,100: The Royal Mummies. By G. Elliot Smith, F.R.S. Pp. vii+118+103 plates. (Le Caire: Imprimerie de l'Institut Français d'Archéologie Orientale, 1912.)

(2) *British School of Archaeology in Egypt.* Studies Series. Vol. iii. The Formation of the Alphabet. By Dr. W. M. Flinders Petrie, F.R.S. Pp. iv+20+9 plates. (London: Macmillan and Co., Ltd., and Bernard Quaritch, 1912.) Price 5s. net.

(1) PROF. ELLIOT SMITH'S studies of mummification, the result of work carried out during the years he spent in Egypt,

have been brought to a fitting conclusion by the issue of this sumptuous catalogue of the royal mummies in the Cairo Museum. The work forms an exhaustive supplement, from the anatomical side, to Sir Gaston Maspero's monograph on the same subject. We meet with many old friends, but there is scarcely one about which the author has not something new to tell us. The earliest and perhaps the most tragic of these dead kings is the seventeenth dynasty Pharaoh Seqenen-Ra, whose agonised hands and battered face and skull bear witness to a violent death upon the field of battle. We note that Prof. Elliot Smith supports Maspero's view that the body was hastily mummified on the field, not transported to Thebes and subjected to partial decomposition, as Dr. Fouquet would have it. Another interesting mummy, or rather skeleton, is that of the heretic King Akhenaten, which was found five years ago by Mr. Theodore Davies in the tomb with Queen Tii's furniture, and was at first supposed to be that of the queen herself; we are glad to have the anatomical evidence as to age, &c., set forth in greater detail.

A subject of controversy on which these important researches throw new light concerns the influence which, it has been supposed, phallic ideas may have exerted on the technique of embalming in Egypt. The evidence against the theories appears conclusive, and cases quoted in support, such as the mummy of Rameses II., can be otherwise explained (see especially p. 61).

It is perhaps scarcely necessary to add the warning that the catalogue is for the scientific, not the general reader, who would find that much of it reads like a detailed report of a series of post mortem examinations; some of the photographs, too, though of the greatest possible value for the anthropologist, are naturally rather gruesome. But, as Prof. Elliot Smith justly remarks, since these valuable historical "documents" have come into our possession (mainly, it may be added, through the depredations of ancient Egyptian grave-plunderers), it is the duty of the man of science to read them as fully and as carefully as possible.

(2) In his latest work, "The Formation of the Alphabet," Prof. Flinders Petrie has given us fresh proof of his versatility. De Rougé's theory of the derivation of the Phœnician alphabet from the Egyptian hieratic writing of the twelfth dynasty is now generally discarded, and some ingenious theories have within recent years been propounded in its place. Prof. Delitzsch, of Berlin, for instance, has worked out for it an elaborate cuneiform ancestry; while Prof. Sayce has more recently suggested a purely Semitic source in Syria. Prof. Petrie holds that, instead of coming into existence as a small alphabet, enlarged and corrupted by later additions, its evolution was spread over a far greater area and longer period. It had its origin in a gradually formed signary, current far and wide throughout the ancient world, until it was slowly contracted and systematised. Thus the majority of the signs Prof. Petrie would trace back to a remote antiquity, no fewer than forty-four of his sixty elements beginning with pottery-marks in prehistoric Egypt. We have not space to discuss this very attractive theory in detail, but we would suggest to the professor in quite general terms the possibilities of fortuitous resemblance in cases of parallelism where the lines of cultural contact seem remote.

L. W. King.

PHILOSOPHY AND ETHICS.

(1) *The Dynamic Foundation of Knowledge.* By Alexander Philip. Pp. xii+318. (London: Kegan Paul, Trench, Trubner and Co., Ltd., 1913.) Price 6*s.* net.

(2) *High-School Ethics.* Book I. By J. Howard Moore. Pp. xiv+182. (London: G. Bell and Sons, Ltd., 1912.) Price 2*s.* 6*d.* net.

(3) *The Positive Evolution of Religion: Its Moral and Social Reaction.* By Frederic Harrison. Pp. xx+267. (London: William Heinemann, 1913.) Price 8*s.* 6*d.* net.

(4) *The Value and Destiny of the Individual.* The Gifford Lectures for 1912. Delivered in Edinburgh University. By Dr. B. Bosanquet. Pp. xxxii+331. (London: Macmillan and Co., Ltd., 1913.) Price 10*s.* net.

(1) ENERGY is the real thing, not matter. The keynote of philosophy is change. Sensation is not sensation of thing changing and of change; it is simple consciousness of change. Change implies power. All science is an interpretation of appearance in terms of power, which is the fundamental postulate. And our notion of power arises from our awareness of our own motor activity, which awareness is one of the first data of experience. Causation is a derivative postulate arising from this same awareness of self-activity; if we were passive photographic plates, we could have no conception of causality. We attribute potent efficacy to the things of sense which resist us, on the analogy of our own activity.

Philosophic systems come and go, as did theological discussions in their mediæval day; but the hope of the future is in the triumph of science. It offers the clue, viz., "to conceive of things in terms of their organic potency."

Reality is an ever-transmutable energy, and with this conception the contradiction between materialism and idealism is got rid of.

The book is well written, and contains much sound analysis of perception and the like, with much that is debatable but suggestive and stimulating.

(2) Lectures delivered by the author at the Crane Technical High School, Chicago, in his department as instructor in ethics; the volume is Book I. in a four-years' course which he is working out. It is not a text-book of "ethics" as we understand the word over here, but a series of moral lessons aiming at the improving of character rather than the imparting of knowledge concerning a science. They are admirably arranged, and deal with honesty, industry, earnestness, obedience, courtesy, self-control, sport and its cruelties, &c. Suitable anecdotes are introduced, and the style is breezy and interesting. It is to be hoped that many schools will use this pioneer volume as a manual. As Mr. Moore remarks, we have scarcely yet begun to educate the human young. When we become enlightened, we shall not consider when a new being comes into the world that the first and most important thing to do is to pounce upon him and teach him to read and write. The art of putting oneself in the place of others is a more important art, and the inculcation of this is a more important anxiety in child education than the art of reading and writing. It is noteworthy that the Illinois legislature passed a law three years ago requiring the teaching of morals and humanity in all the public schools of the State for thirty minutes every week. Illinois was the fourteenth State to adopt such a law.

(3) Mr. Harrison is always readable, and this collection of essays and discourses will serve as a useful popular compendium of Positivist doctrine. It suffers in places from a certain garrulity, and also the reader occasionally feels that the author is laboriously slaying the slain—as when he refutes "orthodox criticism," with its "scheme of personal salvation" and its "Almighty, Absolute, incomprehensible God." And, in view of the parade of "science" and "logic," he is rather dogmatic, though at the same time vague and general—*e.g.* "there can be little doubt that the average Orthodox Dissenter is far inferior in learning, culture, and breadth of view and nature to the average Churchman" (p. 171). These hasty personal judgments are injudicious, and, besides, such phrases as "average Orthodox Dissenter" and "average Churchman" are too vague to be of much use. It may even be doubted whether Mr. Harrison knows much about Dissent, for he speaks of some unnamed publication as the "authoritative organ of Orthodox Nonconformity" (p. 207). No such publication exists. Most of the greater dissenting sects have their own organ, but no one of these speaks for all. And, indeed, what *is* "Orthodox Nonconformity?" On the question of miracles, Mr. Harrison uses the antiquated phrase "suspension of the laws of nature," and talks of "violation" quite in the style of Hume. Surely after Mill and Huxley this language ought not to be used. With Mr. Harrison's agnosticism about a "Creator," and his emphasis on social effort and character-building, probably most scientific readers will heartily agree.

(4) After Mr. Harrison's relegation of metaphysics and absolutes to the lumber-room of outworn things comes Dr. Bosanquet's "truth which for us is now established, of the reality and perfection of the Absolute" (p. 260). No doubt they will read each other's books—or perhaps they will not—and will remain of the same opinion still. But there is a great difference between the two, in the eyes of what Mr. Harrison would probably call an "average reader." The one is a *littérateur*, the other is a thinker and philosopher. We have no space for an adequate review of Dr. Bosanquet's book (which embodies the Gifford lectures for 1911–1912), and must content ourselves with saying that the title well describes the contents, and that the author's view of time seems more satisfactory than that of Bergson, which he criticises.

OUR BOOKSHELF.

Plant Diseases. By Dr. Werner F. Bruck. Translated by Prof. J. R. Ainsworth-Davis. Pp. 152. (London: Blackie and Son, Ltd., 1912.) Price 2*s*. net.

It is difficult to see to what class of readers this book can be of use. The book claims to be "a concise introduction to the subject of plant diseases," and the field surveyed is very wide, fungous and animal parasites and diseases caused by adverse cultural or weather conditions being included. Except in a few instances, as, *e.g.* in the chapters on diseases of coniferous wood and on beet and mangold diseases, little is said on the changes produced by disease in the plant. In some cases the enumeration of the "pests" carries no information at all, *e.g.* in the list of "animal pests" of leguminous plants there is a bare list of nine names. Unfortunately much of the information is given in so vague a manner that the book cannot be recommended as a "primer" for the student, and it does not claim to give the detailed advice as to remedies necessary for the practical grower. One wonders what idea a student would carry away after reading the following description (which is unaccompanied by any illustration):—"The *aecidium* is found below the cortex of a stem or the epidermis of a leaf"; and shares his bewilderment on reading, in the paragraph dealing with cultural methods, the sentence:—"Artificial solutions . . . ought to contain the substances present in the diseased specimens."

Although "mykoplasm" is mentioned, no reference is made to the discovery of "specialisation of parasitism" by Eriksson and others. This leads the author wrongly to assume that the hop and pea mildews spread from their numerous wild host-plants to the cultivated plants in question. The view expressed that *Nectria ditissima* is always the secondary and not the primary cause of apple-"canker" was disproved some time ago. By a slip *Fusicladium dendriticum* is stated to attack pears; and it may be pointed out that Alternaria is not an Oomycete, Hypochnus is not an Ascomycete, and that green vitriol is not copper sulphite.

The illustrations are bad, some extraordinarily so—*e.g.* those of corn-mildew, vine-mildew, apple-scab, and Orobanche. The last-named is certainly worthless; six botanists (all familiar with the plant), to whom it was shown by the reviewer, all failed to recognise the plant.

The best we can say is that the descriptions of the various fungi mentioned are clear, and the book is very free from misprints. E. S. S.

Technical School Organisation and Teaching. By C. Hamilton. With a preface by G. Udny Yule. Pp. xii+178. (London: George Routledge and Sons, Ltd., 1913.) Price 2*s*. 6*d*. net.

The great and rapid changes which have recently taken place in the organisation of technical education in evening schools have (says Mr. Yule) created a demand for a new series of text-books specially adapted to the new circumstances. The present volume is issued as a general introduction to the series. Its aim is to define the proper scope and function of evening school work, to discuss the organisation necessary to make that work effective, and to provide—especially for those who, without previous training or experience, become instructors in evening schools—a simple exposition of the chief principles of teaching. It is evident that the author has excellent qualifications for performing his task. In his introductory section he shows so clear a grasp of the problems of evening school work, so sane a view of its possibilities and of the part it should play in a national scheme of education, that he gains at once the confidence of his readers. The same lucidity, liberality, and practical good sense characterise the subsequent section on the arrangement of courses, the details of administration and the functions of examinations. The final sections show a refreshingly sound appreciation of the principles of method, and much skill in applying them to the special problems of the technical teacher. It is probable that these 120 pages will prove the most helpful and informative part of a thoroughly useful book. T. P. N.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

An Attempted Photochemical "Resolution" of Silver.

The recent correspondence between Prof. Schuster and Mr. Soddy in these columns suggests the placing upon record of a bold but unsuccessful attempt to split up the element silver which I made some years ago with one of my students. In these days, when tentative speculations are figuring so largely in the scientific world for positive knowledge, it may be necessary to point out that the research was prompted by no theoretical views concerning the compound nature of silver. But while there was no special *a priori* reason for suspecting the elemental character of that metal it was well known as a fact that its chloride, &c., on exposure to light only underwent a limited decomposition—*i.e.* that the photo-reduction ceased when a certain minute proportion of "photo-salt" had been formed. The consideration of this property of the silver halides suggested the interpretation (purely hypothetical!) that the "element" contained a constituent (say, α-silver) of which the chloride was sensitive to light, and another (say, β-silver) less sensitive or insensitive to light. From this it followed that if, after exposure and complete saturation with "photo-salt," the unchanged chloride could be separated from the photo-reduction product, the latter, on reconversion into chloride, should furnish a salt very highly sensitive as compared with the main portion of unchanged chloride.

For various reasons the research was never completed, chief among these reasons being the difficulty of effectively separating the minute trace of photo-reduction product from the large excess of unchanged chloride. Notwithstanding our failure, the experiment might be worth repeating under more favourable conditions since the relative sensitiveness to light of two specimens of silver chloride—the hypothetical α and β modifications—could be easily detected and possibly measured. Even if a negative result is obtained it would seem worth the expenditure of time and trouble in order to set at rest the question raised by the hypothesis. Should the result be positive it is needless to point out that the discovery might have important practical bearings upon photographic processes. It may be worth mentioning that in the course of our experiments it was found that a boiling saturated solution of aniline hydrochloride was a good solvent for silver chloride. What is wanted, however, for the present purpose is some inorganic solvent which dissolves the unchanged silver chloride at ordinary temperatures more freely than the metallic chlorides (lithium, &c.) hitherto used for this purpose. Reagents like thiosulphates, cyanides, &c., which form salts with and freely dissolve silver chloride, appear to decompose too much of the "photo-salt" to be of use in such an inquiry. The bearing of the present discussion upon our abortive attempt to "resolve" silver is sufficiently obvious—is the darkening of a silver salt under the influence of light a case of "physical analysis"? R. Meldola.

Bournemouth, March 22.

Dana's Proof of Darwin's Theory of Coral Reefs.

In connection with Prof. Davis's paper on Dana's proof of Darwin's theory of coral reefs, which appeared in Nature on February 6, it is interesting to point out that land valleys which extend beneath the sea are not always proofs of subsidence. Such valleys, like coral reefs, may owe their existence to different factors in different cases.

The harbours of this coast are the high parts of submarine fault valleys, and the portion bordered by land is often only a small part of the whole. Yet the evidence is very clear that the coast has risen regularly since the Red Sea was made, and that river erosion has had nothing to do with the formation of these steep-sided rifts. The coast of equatorial East Africa is essentially similar, though there the fault features are not so obvious, as they have been smoothed down somewhat by the heavy rainfall. Yet such harbours as Mombasa, Kilindini, Tanga, and Wasin are obviously homologous with those of Port Sudan, Suakin, and the desert harbours of the Red Sea.

Chwaka Bay, on the east coast of Zanzibar, is part of a depression which runs right across the island in a south-west direction, and forms long inlets where it reaches the sea on the other side.

The island of Pemba, a little north of Zanzibar, is dissected in a wonderful way on its west side by long fiords running far into the land, and ending in mangrove creeks, perfect slaver- and pirate-hiding places. The land is comparatively high and of great fertility, so that a coasting voyage among the fiords is one of great pleasure and interest.

Surely these are typical drowned valleys? Not at all; the island, like Zanzibar, was elevated in late Tertiary times, the fossils of its coral cliffs are Pleistocene or recent, and both islands have remained at or near their present level while their reefs were carved out. In places on the east coast of Zanzibar the reef is up to three miles wide, and is something between a fringing and a barrier formation. Yet it was all formed by abrasion of elevated coral land.

Along the edge of the deep water, in a line at right angles to the Pemba fiords, is a regular but broken line of reefs and islands, a typical barrier. Where the islands have not been worn away by the sea they are formed entirely of elevated coral, and the reefs have been formed by abrasion of land. When this process is complete, there will be a typical barrier reef, should the islands continue stationary at the level to which they were originally elevated.

The two islands, Zanzibar and Pemba, were originally regular oval cups of coral (or perhaps saucers rather, as in Pemba coral limestone is seen at lowest tide level a long way up Chaki Chaki Bay), and were connected with the mainland. These were filled with the sand and pebbles which now form most of the hills. After elevation they were cut off from the mainland by marine erosion, possibly (in the case of Pemba at least) also by a comparatively deep fault. Other faults on this side cracked the saucers, and irregularity was further induced by marine abrasion, in some places made excessive by powerful silt-bearing currents, in others neutralised by the protection afforded by growing coral and algæ. As along the deep water conditions more uniformly favour the growth of protecting organisms, the edges of the saucers retain their regularity, while within the mass of sand and the limestone on which it lies is subject to rapid degradation. The fiords are extending into the land among the mangrove swamps at their heads. The roots of the mangroves penetrate the crevices of the coral and cause shallow accumulations of mud, both factors for the disintegration and solution of coral limestone. I take the extremely complicated outline of the south end of Pemba Island to be an example of the barachois described by Prof. Gardiner in the results of the Percy Sladen Trust expedition to the western Indian Ocean.

In the Red Sea the heads of the harbours are being filled in with blown sand and flood-borne alluvium, but in Pemba there are no delta-like formations; the marine currents are far too powerful to allow of them, even if the streams were big enough to convey any quantity of alluvium.

In the Red Sea and equatorial East Africa we thus have, on stationary or rising coasts:—(1) Submarine valleys which are scarcely altered from the original fault rifts; (2) those of similar origin somewhat disguised by the effects of tidal currents and fresh-water streams.

The above have little if any continuation into the land, but in Pemba are found:—(3) Long fiords simulating drowned valleys, but of the same origin as (1) and (2); (4) barrier reefs formed by abrasion alone, in Zanzibar and Pemba.

In the Red Sea are (5) barriers which are features of the sides of a rift valley merely coated with coral.

(6) The barriers of the equatorial coast may be of the same origin as those of the Red Sea, but, if Zanzibar Island be reckoned a part of this barrier, removal of the intervening land has been at least the cause of the final separation, as proved by the fauna of the island. Probably they are comparable to the barrier of the west side of Pemba in structure and origin, due to the faulting and erosion of the heterogeneous material of coral deposits.

My statements here are dogmatic for want of space, but details are given in my papers in Proc. Camb. Phil. Soc., 1902, and Journ. Linn. Soc., vol. xxxi., 1907 and 1911.

My being in a distant and isolated village, which is, however, a few yards from coral reefs, is my excuse for the delay in your receipt of this contribution to the discussion. CYRIL CROSSLAND.

Dongonab, Red Sea, February 24.

Elliptical Lunar Halos.

ON the morning of January 26, 1908, while observing with the Keeler reflector of this observatory, I noticed a curious lunar halo, which I described as follows in the notes made at the time:—

"At 4.25 a.m. (Eastern standard time) I saw an elliptical halo close to and concentric with the moon. Its major axis was vertical, and was about 7° long, the lunar diameter being used to make this estimate. The horizontal axis was a little less than half the vertical, or about 3°. The halo lasted only about one minute, but was unmistakable, being well defined (except near the bottom) on both its inner and outer edges. It reappeared less distinctly at 4.31 a.m., lasting only a few seconds. I watched the moon until 4.50 a.m., but saw no third appearance. The halo was white in colour. There was a light east wind blowing at the time, and there was a little haze in the sky. The temperature was 28° F., and had been very constant all night. The moon was at last quarter."

At my request the other observers here have watched for such a halo, and on December 1, 1908, both Prof. Jordan and Dr. Baker witnessed a much longer appearance of it. Prof. Jordan's notes read as follows:—

"An elliptical lunar halo was visible here on the evening of December 1, 1908. The night began with a very clear sky, but about eight o'clock a slight haze became visible in the neighbourhood of the moon. This soon began to take definite form, and the halo developed. It remained visible until about 9 p.m., when it gradually disappeared and the sky soon became cloudy. The halo varied greatly in brightness because of the varying amount of haze in the atmosphere: very definite and bright when the amount was large, and occasionally disappearing in part or even completely as the atmosphere cleared. Sometimes the whole halo became uniformly faint, while at other times portions of the circumference disappeared. The major axis was vertical, the moon being about on the meridian. The axes were estimated to be about 7° and 4° respectively, but no careful measures were made. The colour, if any, was very slight. The moon was at first quarter."

None of my astronomical friends to whom I have described these elliptical halos has ever seen one. They must be rare phenomena, and well worth recording. FRANK SCHLESINGER.

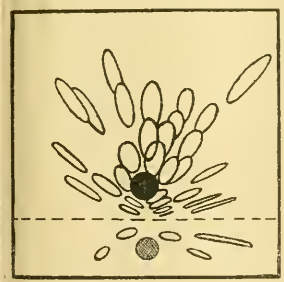
Allegheny Observatory, February 24.

The halo appears to be that known as "Hall's halo," but the diameters given are rather less than those observed by Hall. The phenomenon is mentioned in Pernter's "Meteorologische Optik" (p. 262), and an explanation is suggested by him on p. 381 of that work. [ED. NATURE.]

The Reflection of X-Rays.

IN continuation of the experiments of Mr. W. L. Bragg (NATURE, December 12, 1912, p. 410), I have investigated the reflection of X-rays by mica. Mr. Bragg finds one reflected beam, while Messrs. Hupka and Steinhaus (NATURE, March 6, 1913, p. 10) find two beams. Using a parallel pencil and an angle of incidence of 70°, I find no difficulty in photographing five beams emerging from the "incident" side of the mica, of which that obeying the ordinary laws of reflection is the most obvious.

From the "transmitted" side of the mica sheet there are certainly no fewer than thirty distinct beams apart from the intense primary beam which has passed through the crystal (0·33 mm. thick) without much absorption. The plane of the mica sheet was perpendicular to that of the photographic plate. In the reproduction given below, the intense black spot is produced by the transmitted primary beam, while beneath it is seen another circular patch due to the ordinary reflected beam. The greatest photographic intensity occurs in those transmitted beams which have suffered the least deviation, the ordinary reflected pencil being feeble in comparison with some of them.



It will be evident that the transmitted pattern is analogous to that obtained by Messrs. Laue, Friedrich, and Knipping (NATURE, November 14, 1912, p 306), using a pencil of X-rays falling normally on a crystal of zincblende. Repeating my experiments, using a normal pencil, a transmitted pattern is obtained similar to theirs.

Besides giving rise to numerous pencils in definite directions, the mica sheet exhibits the ordinary incident and emergent scattering. It is well known that this effect is small in the plane of the radiator. This is borne out in all the negatives which exhibit general fogging, except along a line which represents the line of intersection of the photographic plate by a plane containing the mica sheet. This line is represented in the diagram by the broken line. Similar results are obtained using rock salt and galena.

Since the photograph described above is unsuitable for reproduction by a half-tone block, I have been obliged here to substitute a diagrammatic copy for it.

H. B. KEENE.

Physics Department, University of Birmingham, March 15.

The Presence of Protozoa in Soils.

UP to the present, so far as I am aware, the only method of demonstrating the presence of Protozoa in soils has been by cultures. This method, of course, leaves untouched the really important question as to what Protozoa are leading a trophic existence at any given time in a soil sample, since many of the forms found later on in cultures may be derived from cysts. In these circumstances I thought it might be of interest to direct attention to a method by which the presence of Protozoa in the trophic stage in the soils can be readily demonstrated, even though this method from a quantitative point of view probably gives low results.

A small quantity of the soil to be investigated is mixed, as soon as it is collected, with about an equal volume of picric acid. The mixture is then placed in a wide dish and carefully stirred, so that the organisms on the surface films between the soil particles are free. If the mixture is then allowed to stand for a time it will be found that most of the bacteria, diatoms and Protozoa that were present come up to the surface film. The coverslips, cut according to the method which I have previously described, can then be floated on the film, and then placed in tubes containing corrosive. These cover-slips can then be handled as though they were ordinary smears. The best method of staining seems to be to stain for some time in strong acid haemalum, followed by eosin. I have tried mixing the soil in the first instance with other fixatives in the place of picric acid, but have not obtained such good results. By this method perfectly clean preparations, showing large numbers of amœba and flagellates, have been obtained from a six weeks old bed, which had been used for growing seedling cauliflowers. These have been used to compare the active fauna of such a soil with the fauna derived from the same soil in cultures.

As might be expected, it has been found that the prevalence of any given Protozoon in the cultures is not an indication of its prevalence in the trophic stage in the soil, though by varying the methods of culture it has been found possible to cultivate all the Protozoa that have been found by the above method leading a trophic life in this soil at the date of fixation.

C. H. MARTIN.

The Hill, Abergavenny, March 19.

Jelly-fish of the Norquane River.

THE discovery of a jelly-fish in the northern watershed of the Limpopo will be of some interest to zoologists.

During the new year holidays, while making zoological collections in the Bembezi district (thirty miles north-east of Bulawayo), I noticed some jelly-fishes in a pool of the Norquane River, a tributary of the fourth degree of the Limpopo.

With the scanty literature at my disposal, it is not possible at present to identify or determine it as a new species, but judging by the figures in Lankester's "Treatise on Zoology" and in the "Cambridge Natural History," and also by Mr. Moore's statement ("The Tanganyika Problem") that *Limnocnida tanganyikae* varies in size from that of a shilling to a two-shilling piece, and is as flat as those coins, these jelly-fishes are not referable to that species.

In life, they are almost hemispherical and slightly flattened on top; the largest do not measure more than 16 mm. in their widest part, and the smallest measure about 6 mm.

The Norquane is a narrow stream with a sandy bed cut into a succession of pools by granite bars. In all the pools over a distance of a mile, hundreds of the jelly-fishes were to be seen. The first specimen was found in a pool about 20 ft. by 30 ft. and 7 ft. deep, late in the afternoon, and a careful search did not at first reveal any more. Shortly after my having a bathe in the same pool, numerous specimens came to the surface, and subsequent observation showed that the creatures swim near the surface in the earlier part of the day, and retire to the deeper water during the hotter hours, from which they were disturbed by the bathing. Their stinging powers, however feeble, probably render the jelly-fishes unpalatable to the fishes in the pool (chiefly *Barbus 3-maculatus* and Tilapia sp.), which left them severely alone.

I hope to be able soon to obtain Günther's paper in the *Q.J.M.S.* on *Limnocnida tanganyikae*, when it will be possible to decide whether or not this is a new and the fifth known species of fresh-water medusa. I should add that a careful examination of several pools during three days failed to reveal any signs of a hydrosome stage.

G. Arnold.

The Rhodesia Museum, Bulawayo, February 21.

An Experiment for Showing Lines of Force in an Electrostatic Field.

The general directions of the lines of force between charged conductors can be shown by a method which, though extremely simple, shows as much as the elegant but somewhat elaborate apparatus described by Mr. R. F. D'Arcy (Nature, March 20) would seem capable of.

It is simply to allow a scrap of cotton-wool to fall between the knobs of a Wimshurst machine, or among any conductors connected with them. As soon as the bit of fluff touches one of the conductors it moves off rapidly along a line of force. If the other conductor is oppositely charged the fluff will strike it, and again be repelled, usually in a slightly different direction, thus traversing a different line of force, and so on.

The scrap of charged fluff moves so rapidly under the electric forces that, owing to the persistence of vision, the shape of its path is very evident, and, owing to its lightness and the relatively great resistance offered by the air to its motion, its path approximates very closely indeed to the line of force.

Bernard M. Neville.

William Ellis School, London, N.W.

Snail-cavities in Stones.

Referring to Mr. E. W. Swanton's letter in Nature of March 20, may I point out that the Agglestone rock is a sandstone composed of quartz grains bound together by a ferruginous cement.

I believe the excavations of *Helix aspersa* on rock surfaces are produced by chemical action, and that the secretion only acts as a solvent where salts of lime are present. This assumption seems reasonable on the supposition that the snails require lime for the construction of their shells.

Sandstones, unless calcareous, would have to be attacked mechanically by snails for cavities to be formed. Is there any evidence to prove that such cavities have been produced in sandstones?

C. Carus-Wilson.

COMPLETION OF THE DISCOVERY OF THE GREENLAND COASTS.[1]

THE last part of the coast of Greenland to remain undiscovered is the north-eastern tract between Germania Land and the area reached by Peary on his famous journey across the northern ice-sheet to Independence Fiord. This gap has been filled by the Danish expedition under Erichsen, which discovered that instead of the coast continuing in a fairly direct course from Germania Land in 77° N. to Peary Land in 82½° N., Greenland projects in a long peninsula for 5° to the east. The work of the supporting parties of this expedition made some interesting additions to the glacial geology of Greenland, which have been published in Koch and Wegener's memoir on the glacial observations. Erichsen's expedition achieved its object, but he and his two companions, Hagen and the Eskimo Brönlund, perished during the return journey. Brönlund was able to reach nearest home. His body and diary, with a map by Lieut. Hagen, were found by a search-party under Captain Koch. These papers announced the success of the expedition and its tragic end. The journals of Erichsen and Hagen were not recovered, and an expedition to search for them was dispatched under Captain Ejnar Mikkelsen in 1909. This expedition was successful in recovering some messages left by Erichsen in his depôts, but it also nearly perished on the return journey.

The expedition sailed in a small sloop, the *Alabama*, but its plans were disorganised at the start. It called at the Faröe Islands to receive its dogs. But of the fifty dogs which had been bought in Greenland, twenty-three had died on the voyage to the Faröes, and the rest were so diseased that they had to be shot. The *Alabama*, therefore, had to go to the Eskimo settlements in south-eastern Greenland to buy dogs, and was thus seriously delayed. The expedition reached its base, Shannon Island (lat. 75° 10′ N.), on August 27, and a party in the autumn sledged up the eastern coast as far as Lambert's Land (79°), where they found Brönlund's grave. After wintering on Shannon Island, Captain Mikkelsen and Lieutenant Iversen marched across the inland ice to the head of Denmarks Fiord, which had been discovered by Erichsen; they searched its coasts, found the site of Erichsen's camps, and recovered the messages left in them. Mikkelsen had intended to return to the Eskimo settlements on the western coast through the strait which, according to Peary, extends across northern Greenland; but this plan had to be abandoned when it was found from one of Erichsen's notes that "the Peary channel does not exist, Navy Cliff being connected by land with Heilprin Land." The author has commented severely on this mistake, but, considering the sufferings it caused him, his annoyance is intelligible.

[1] "Lost in the Arctic." Being the Story of the *Alabama* Expedition, 1909–12. By Ejnar Mikkelsen. Pp. xviii+400+plates. (London: W. Heinemann, 1913.) Price 18s. net.

The two explorers therefore started back from the mouth of Independence Fiord around the north-eastern peninsula of Greenland in order to reach their base on Shannon Island, 7° to the south. They were delayed by the rotten condition of the thawing ice and the difficulty of crossing the numerous water-leads. They were compelled to wait until the return of colder weather improved the conditions of travel. During most of the return march the two travellers were on very short rations, and the conditions of the season were so unfavourable that there was very little fresh food to be obtained. The seals were so thin that they sank when shot, so seal-meat was not procurable. Both men were attacked by scurvy, from which they were once cured by killing a few birds. Without dog transport their position would have been hopeless; but by eating the last of their dogs they managed to reach some of the depôts that had been laid for Erichsen. When at length they arrived at Shannon Island, they found that the *Alabama* had been wrecked and their companions had left. They had to spend two further winters at their base before their rescue in the spring of 1912.

FIG. 1.—The glacier front. From "Lost in the Arctic."

The main geographical result of the expedition was the discovery from Erichsen's notes that the Peary canal is not a continuous strait but two fiords, so that the northern end of Greenland is not a separate island. Captain Mikkelsen's own work has added to the topography of this most inaccessible part of the Greenland coast. His book is most graphically written; it tells the story of perhaps the most adventurous arctic journey from which the explorers returned to narrate their experiences. The two men succeeded in their errand owing to the same sound judgment and geographical insight which enabled them to survive the terrible hardships of their return journey.

FIG. 2.—Iversen' sledge. From "Lost in the Arctic."

The book does not give any of the scientific results of the expedition, which will no doubt prove to be valuable from an observer of such wide arctic experience as Captain Mikkelsen. The book is illustrated by many instructive photographs, which are arranged haphazard, and by a map which is the most inconveniently placed that we remember to have seen.

CORONÆ, GLORIES, AND HEILIGENSCHEIN.

DURING May and June, 1912, several correspondents described a number of optical phenomena, principally solar haloes, which they had observed just before the commencement of the remarkable haze which covered the sky in the northern hemisphere during the summer months of last year, and a short article dealing with the simpler haloes and mock suns appeared in NATURE (vol. lxxxix., p. 377). Recently attention has been directed to certain less generally known and less majestic phenomena (possibly also less ominous), which are described as (1) coronæ, (2) glories, Ulloa's rings, anthelia, or Brocken spectres; (3) haloes, or more strictly Heiligenschein or dew glories, and a note on these may supplement the earlier article.

Coronæ are luminous rings around the sun or moon, usually, although not necessarily, smaller than the smallest halo properly so called, which has a radius of 22°. The order of their colours is opposite to that of haloes, red being outside and blue inside for each ring. Inside the first ring is the aureole of a peculiar pale-tinted blue near the luminary, with brownish-red next to it. Sometimes the aureole alone is visible.

Coronæ are produced by diffraction either by small drops of water or possibly by ice-needles, although Dr. Simpson, from observations in the Antarctic with a party led by Captain Scott in September, 1911, and from theoretical considerations, concluded that coronæ there were not produced by ice-crystals, but by super-cooled drops of water, and drew the very important deduction that "liquid" water exists in the atmosphere at temperatures far below the ordinary freezing point. The more uniform the size of the drops in the cloud producing a corona, the more brilliant is the phenomenon. The angular radius θ of a coronal ring is proportional to the wave-length λ of the colour of the ring and inversely proportional to r, the radius of the drops, but a small correction is necessary on account of the fact that the sun or moon is not a point-source of light, but has a definite diameter. Observed radii θ must be diminished by 16′ before they are used in the formula $\sin\theta = c\lambda/r$, where c is roughly 0·8, 1·3, 1·9 for the first, second, and third rings. The intensity of the light in the rings is of the order of 1/100 of the intensity of the direct light from the source. The diameter of the drops in clouds producing coronæ varies from about 0·01 to 0·04 millimetres.

Glories are luminous rings seen around the head of the shadow of the observer upon a cloud. They are specially frequent upon mountains, hence the name Brocken-spectre. Antonio de Ulloa, the Spanish captain who took the French scientific expedition to Peru in 1735 and explored the Andes with Bouguer and Condamine, shares with Bouguer the honour of having first given a precise description of the phenomenon which is sometimes associated with his name. Scoresby, the arctic explorer, observed glories frequently in polar regions, with clouds rising from the sea, by climbing the mast of his ship. On one occasion he saw as many as four coloured rings.

Accounts of glories occur on almost every page of the logbook kept by the observers on Ben Nevis, and on one occasion, November 23, 1884, they saw as many as five together, varying in radius from less than 2° to more than 10°. According to Pernter, glories are coronæ produced by reflected light. They are consequently much less intense than direct coronæ, and are usually seen by sunlight. Out of nearly 200 glories described by the Ben Nevis observers, only three were seen by moonlight. Mascart, however, attributes glories to diffraction of the incident light in the same way as if it were travelling in the opposite direction, and against this explanation the objections which Miss A. Everett quotes (January 23) from Prof. Richarz would not hold.

Haloes or glories around the shadow of the head thrown on dewy grass in early morning or evening have been called "Heiligenschein" to distinguish them from haloes of the ordinary type. The "Heiligenschein" is a real phenomenon which can be photographed, and it extends some distance from the edge of the shadow. It is not to be confused with the apparent brightness around the shadow thrown on a flat surface, which is a purely subjective phenomenon. This latter may explain the brightness along the shadow of an overhead tram-wire mentioned by Mr. Merrick in a letter. The Heiligenschein is most clearly seen in meadows where the grass is more or less uniform in length and orientation, and is covered with small drops of dew. The height of the sun should be such that the length of the shadow is 40 ft. or more. The phenomenon is attributed to the light reflected from the spherical dewdrops both directly and after two refractions and one or more internal reflections. These effects give a maximum intensity in the direction of the incident light, the intensity falling off continuously without alternation of colour. It is, therefore, quite distinct from haloes, coronæ, and glories.

The halo on ruffled water described by Prof. Worthington in NATURE of February 13 (p. 647) appears to be akin to Heiligenschein, although the condition of slight turbidity which he postulates suggests that the turbid constituents may act in a similar way to fog particles.

In addition to the letters already published in NATURE, several others have been received. Mr. T. S. Patterson, of Glasgow University, refers to Benvenuto Cellini and the consolation which golfers may gain by contemplating the Heiligenschein when they are searching in the lengthening shadows for a missing ball; Mr. G. A. Shakespeare, of Birmingham University, also refers to Cellini and to the subjective effect at the edge of a shadow, and to the peculiar effectiveness of the leaves of the white pink in producing Heiligenschein; Mr. G. Merrick, of Newcastle, states that he has observed Heiligenschein around the head of a person 4 ft. from him—an unusual occurrence—and along the shadow of an overhead tram-wire; Mr. G. M. Davies, of Croydon, describes an observation of a "glory" on Snowdon at 3 p.m. in September, 1905; Mr. Howard Fox, of Falmouth, relates an experience in Cornwall forty years ago as he was driving along the road, when he saw a glory on a low fog, followed later by a white "fog-bow." A note has also been received of a "halo" of about 15° diameter seen on the surface of Lake Suwa in Central Japan by Viscount Tanaka. In this case the phenomenon might be attributed to diffraction by minute water-drops condensed in the air just above the surface of the lake, but such an explanation would fail if, as stated, the colour-bands were radial. The phenomenon is discussed in an article (in Japanese) in the Journal of the Meteorological Society of Japan (December, 1912).

"H. V. G." refers to the radial appearance of dust on the surface of a mirror owing to the particles of dust and their images presenting to the eye the appearance of short straight lines.

E. G.

THE OIL-SHALES OF THE LOTHIANS.[1]

THE memoir on the oil-shales of the Lothians published by the Geological Survey of Scotland in 1906 contained so much valuable information that the first edition was exhausted in 1911, and the second edition, brought thoroughly to date, has now been issued, and forms a most welcome and valuable addition to our knowledge at a time when the Scotch shale-oil industry is exciting so much interest as a possible asset to the Empire in the supply of fuel oil.

Nearly the whole of the industry is confined to a belt of land some six miles in breadth, which stretches from near Dalmeny on the Firth of Forth in a southward direction to the moorlands around Cobbinshaw and Tarbrax. The first portion of the memoir is devoted to the geology of this shale-oil field, the survey of which was commenced by Sir Archibald Geikie in 1857, carried on by Mr. H. M. Cadell and the late Mr. James S. Grant Wilson, and is now brought up to date by Mr. R. G. Carruthers. The second part deals with the methods of working the oil-shales, and has been entrusted to Mr. W. Caldwell, whose wide experience as mining engineer to the Pumpherston district makes this section of special value: whilst in the third and concluding portion of the work Mr. D. R. Steuart describes the treatment of the shale from the time it leaves the mine until its products are ready for marketing.

The history of the shale-oil industry is one that always appeals strongly to the imagination as an illustration of how every obstacle can be surmounted by dogged perseverance and determination, and the fact that to-day the industry still holds its own after a forty years' war with the powerful oil combines of America and the East is one of which every British subject should be proud.

The late Lord Playfair often declared that he was the founder of the Scotch shale-oil industry, and certainly it was he who in 1847 directed the attention of James Young to a trickle of oil from the shale in the Riddings Colliery, near Alfreton. On distilling this oil Young produced an excellent lubricant, the demand for which soon exhausted the supply, and imbued with the idea that the oil had been formed by a low temperature distillation of the coal, he experimented with many varieties and found that boghead cannel from West Lothian was best suited for his purpose. In 1850 the Bathgate works were started by Messrs. Young, Meldrum and Binny, and for twelve years the boghead coal, or Torbanehill mineral as it was often called, yielded an ample supply of oil for illuminating and lubricating purposes, as much as 120 gallons of crude oil per ton being obtained from it.

The supply of this material becoming exhausted, in 1862 shale was used in its place, but yielded only a third of the volume of crude oil; in spite of this, the expiry of Young's patent in 1864 led to a rapid expansion of the shale-oil industry, which, however, received a severe check soon after. In 1859 Drake had discovered how to obtain natural oil in enormous volumes by boring in Pennsylvania, and by 1864 it began to be imported into England in large quantities, with the result that lamp oil, which during the existence of Young's patent had varied from 3*s*. 6*d*. to 2*s*. 6*d*. per gallon, fell to 1*s*. 5*d*. to 1*s*., whilst, to make matters worse, the Americans began to import into this country lubricating oils and paraffin wax, which before had been practically a monopoly with the Scotch distillers.

In 1873 the Russian fields also entered into the competition, and for a time it appeared as if the Scotch industry must succumb, but by amalgamating the small works with the larger, by organisation, the adoption of labour-saving appliances, and the introduction of every form of economy the crisis was survived, and the manufacture of sulphate of ammonia from the nitrogen in the shale helped the Scotch oil industry to hold its own in spite of the overwhelming odds.

In 1871 there were fifty-one works in Scotland, producing 25,000,000 gallons of crude oil per year, but in 1894 these had been reduced to thirteen oil companies, and at the present time there are only seven, but the production of crude oil has risen to 70,000,000 gallons.

[1] Memoirs of the Geological Survey, Scotland. The Oil-shales of the Lothians. Part I., The Geology of the Oil-shale Fields. By R. G. Carruthers, based on the work of H. M. Cadell and J. S. Grant Wilson. Part II., Methods of Working the Oil-shales By W. Caldwell. Part III., The Chemistry of the Oil-shales. By D. R. Steuart. Second Edition. (Edinburgh: Morrison and Gibb, Ltd., 1912.) Price 2*s*. 6*d*.

At the present time two of the most important questions in the public mind are how the enormous demand for motor spirit that has of late developed is to be met, and the imperial question of securing fuel oil for our Navy in the case of war interfering with our over-sea supply, and it will be of interest to see how far the Scotch shale-oil industry can help in these directions.

The rapid increase in the number of motor-driven vehicles during the past few years has doubled the consumption of motor spirit since 1908, the amount used in this country during 1912 reaching the enormous total of 80,000,000 gallons, whilst the quantity of motor spirit produced by the Scotch distilleries would be about 600,000 gallons, or 0·75 per cent. of the total used, an amount which is practically negligible. Considerations of safety on board limit the proportion of the oil that can be used for naval fuel, and the total amount of oil of satisfactory character that is at present produced by the Scotch industry and would be available for such purposes would be only about 50,000 tons, which again is only a small fraction of the quantity needed, but the proximity of the shale fields to the new naval base at Rosyth encourages the hope that the Government will secure and accumulate a sufficient quantity of liquid fuel from this source to safeguard the supply in case of war.

In the portion of the memoir dealing with the chemistry of the oil-shales, Mr. Steuart has collected a mass of most interesting facts, not only with regard to the shale oil, but also bearing upon the probable formation of the shale beds, and the whole work is so full of interesting and suggestive points that no one interested in oil or allied subjects should fail to read it.

THE ANALYSIS OF COLOURING MATTERS.

The Eighth International Congress of Applied Chemistry, which was held in New York in September last, adopted a report submitted by a subcommittee of the Commission Internationale d'Analyses, to which was referred the question of the possibility of unifying the methods of analysis of organic colouring matters.

The subcommittee was international and very representative in character, the British members being Prof. E. Knecht and Mr. C. Rawson of Manchester. The report, which was presented by the president, Dr. F. Reverdin (Switzerland), in a short historical summary of the subject, states that the first systematic scheme was that of O. N. Witt, who, in 1886, suggested a differentiation of the various types of colouring matters by their behaviour on reduction. This reaction, developed and improved by other workers, notably by A. G. Green, is now the basis of the usual method of identification. So early as 1874 Kopp proposed the use of the characteristic absorption spectra of dyes as a means of identifying them, and this method has been greatly improved and extended by Formanek, Grandmougin and others. The photo-spectroscopic method proposed in 1911 by Porai-Koschitz and Auschkap has not yet been much used.

The individual reports from the various national representatives, which constitute the bulk of the report, deal mainly with the analysis of colouring matters for Customs purposes.

The subcommittee finally reports that the unification of the methods employed in the analysis of colouring matters is not possible in the present state of the industry, and would not be of much practical use. It considers, however, that an international agreement would be advantageous in certain cases, such as that of the organic dyestuffs used in colouring foodstuffs, and also where the assessment of Customs duties is required.

The subcommittee has therefore been reappointed by the International Commission of Analysis and instructed "to investigate special cases in which the unification of the methods of analysis of organic dyestuffs offers some interest from the international standpoint."

The committee requests that anyone interested in the subject will communicate information or suggestions to the president (Dr. F. Reverdin, Geneva) or to the British representatives above named.

NOTES.

The death of Lord Wolseley on March 25, in his eightieth year, should not pass unrecorded in a scientific journal, for he was distinguished among great soldiers by his devotion to scientific methods. His capacity for organisation, recognition of the value of knowledge, and regard for accuracy and completeness are attributes not always associated with military careers. His "Soldier's Pocket-Book," now published by the War Office, is rich in details relating to medical, engineering, and other aspects of field operations which depend upon science for their success. He held that it was essential for every officer to have a good knowledge of his science in order to be able to apply that knowledge usefully in the field, when cut adrift, perhaps, from civilisation. We share with the rest of the nation the feeling of regret that a life which has brought so much credit to the British Army is now ended. Lord Wolseley's body was laid to rest in St. Paul's Cathedral on Monday, with impressive funeral ceremonies, but his works will long remain a monument to his memory.

The construction of trustworthy and enduring flying machines has been much encouraged by various large money prizes given by *The Daily Mail*. When in 1906 our enterprising contemporary offered a prize of 10,000*l*. for a flight by aëroplane from London to Manchester in twenty-four hours, with not more than two stoppages, there was little anticipation that it would be won, yet M. Paulhan accomplished the feat in 1910. A further prize of 10,000*l*. for a circuit of Great Britain, covering a distance of 1000 miles in one week, with eleven landing-places, or control stations, at each of which a descent had to be made, was won by M. Beaumont in 1911. Now *The Daily Mail* offers a third prize of 10,000*l*. for a flight by waterplane either way across the Atlantic in seventy-two continuous hours, without any limitation as to nationality of pilot or place of construction of the machine. A prize of 5000*l.* will also be awarded to the pilot who takes a waterplane of entirely British invention and construction round England, Scotland, and Wales, and within one mile of Kingston Harbour, in seventy-two continuous hours. The waterplane is a very promising type of aircraft, and we have little doubt that both prizes will eventually be won. From a national point of view it is important that encouragement should be given to the design and performance of a machine which can start from a water surface or come to rest upon it. The prescribed tests are severe, but not more so than are necessary to decide the efficiency of the waterplane both as regards flexibility and range of action. The new prizes offered by *The Daily Mail* will encourage aviation engineers and pilots to produce a machine by which the two courses will be successfully traversed, and thus bring us nearer that conquest of the air which will be the distinguishing characteristic of the present century.

In America it is quite common for waters to have an unpleasant fishy, oily, or "geranium" taste, due to the excessive growth of certain algæ. Some species grow best during the colder months of the year, others attain their maximum development during the summer. The water supplies of the United Kingdom are usually free from these unwelcome visitations, but many instances have occurred of temporary unpleasantness arising from this cause. London has been singularly fortunate in this respect, yet there can be no doubt that the present commendable policy of storing river water antecedent to filtration increases the risk of algal troubles arising in the future. At Easter time the consumers of West Middlesex water became unpleasantly aware that the supply had a peculiar aromatic taste and smell, which, with apologies to horticulturists, may be likened to geraniums. The water is derived from the Thames, and is stored for a long period in the Staines reservoirs. After re-storage at Barn Elms and Barnes, it is filtered and pumped into supply from the Hammersmith side of the river. First the complaints arose along the line of direct supply from the pressure mains, later the Hampstead area became affected owing to the back-flow of tainted water which meanwhile had accumulated in the service reservoirs. Dr. A. C. Houston informs us that the growth was largely composed of Tabellaria, together with some Asterionella, and the taste developed chiefly during the process of filtration. Remedial measures were at once carried out, and all the implicated filter beds were closed, with immediately satisfactory results. The water, although unpalatable, was at no time unsafe for drinking purposes. The best way of killing algæ is to treat the affected water with copper sulphate (dose, from 1 to 10 lb. per million gallons), and Dr. Houston has found that the most satisfactory way of removing the taste from a water which has become already tainted is to use potassium permanganate (dose, about 2·5 to 5 lb. per million gallons).

The International Geographical Congress was opened at Rome on March 27 by King Victor Emmanuel. We hope to give an account of the proceedings in an early issue.

We are informed that the Royal Botanic Gardens Department, Ceylon, has been replaced by a Department of Agriculture, and that communications should in future be addressed to the Director of Agriculture, Peradeniya, Ceylon. The work of the Royal Botanic Gardens will be continued under the new department.

On the nomination of the Gassiot Committee of the Royal Society, the Meteorological Committee has appointed Mr. L. F. Richardson, assistant lecturer in physics at the Municipal School of Technology, Manchester, to be superintendent of the Geophysical Observatory at Eskdalemuir, in succession to Mr. G. W. Walker, resigned.

The Vienna correspondent of *The Times* announces that Prof. J. Hampel, the eminent Hungarian archæologist, died at Budapest on March 25. As one of the directors of the National Museum and the leading authority on the pre-Christian archæology of Hungary, Prof. Hampel was held in high esteem in his own country and in archæological circles throughout Europe.

We are informed that the optical and mechanical engineering works of Ernst Leitz, of Wetzlar, which recently completed their 150,000th compound microscope, have presented this instrument to his Excellency Prof. Ehrlich, of Frankfort-on-Main, thus doing honour to a genius of scientific discovery. It may be remembered that the 100,000th Leitz microscope was presented to the late Prof. Robert Koch, the famous bacteriologist, who was director of the Imperial Institute for Infectious Diseases, Berlin.

Arrangements are being made for the starting, in July next, of an expedition to Crocker Land, under the auspices of the American Museum of Natural History and the American Geographical Society. One of its special features will be a seismological investigation. The seismograph, which will be in charge of Ensign Fitzhugh Green, of the U.S. Navy, is of the Weichert horizontal type, and carries a stationary mass of 80 kilos. It will be sheltered in a hut of special design, so arranged as to preclude violent changes of temperature. The instrument will be furnished by Georgetown University, Washington, and an attempt will be made to carry on daily communication, by means of wireless messages, between the explorers and the seismographers of the University.

The inauguration of a new President at Washington has necessarily been followed by many changes in important Federal offices. Among them is the appointment of Dr. D. F. Houston to be Minister of Agriculture, succeeding Mr. J. Wilson, who has held that post continuously for sixteen years, under four administrations. Dr. Houston was president of the Agricultural and Mechanical College of Texas from 1902 to 1905, and of the University of Texas from 1905 to 1908. Since that date he has been

Chancellor of the Washington University at St. Louis. He is now in his forty-eighth year. A change has also been made in the assistant secretaryship of the Department of Agriculture, where Mr. W. M. Hays is succeeded by Mr. B. T. Galloway, who has been since 1900 chief of the Bureau of Plant Industry. Mr. Galloway had previously spent twelve years as chief of the Division of Vegetable Pathology and Physiology. Before entering the Government service he was an assistant in the horticultural department of the University of Missouri, of which he was a graduate in agricultural science. He is the author of a large number of works on botany and horticulture.

An official guide, who commenced his duties on April 1, has been appointed to conduct parties of visitors round the collections in the Royal Botanic Gardens, Kew. Two tours will be made daily, except on Sundays and public holidays; one of about an hour and a half, starting at 11.30 each morning, and one of about an hour at 3 each afternoon, except during June, July, and August, when the afternoon walk will start at 5. Morning parties will be limited to six persons, and will visit the plant houses and museums; in the afternoon twenty persons will be conducted round parts of the outdoor collections. In the morning each member of the party will be charged 2*s*. 6*d*., and in the afternoon the charge per person will be 1*s*. Visitors wishing to join a party should attend at the stone portico of Cambridge Cottage, Kew Green, shortly before the time of starting. The new arrangement will meet the needs of those visitors who, in addition to their desire to enjoy the beauty of the gardens, wish to understand something of the scientific value and botanical significance of the unique exhibits at Kew.

Disastrous floods have followed the severe windstorms in the United States on March 23. The areas chiefly affected are the middle western States. The storms seem to have started on the eastern side of the Rockies, and to have rapidly developed energy occasioning the heaviest rains in the Ohio and Mississipi valleys. Immense tracts of country have been submerged, and many large towns have become flooded. Much of the ground is below the flood level of the rivers, and in parts the embankments have given way, whilst many tributary rivers have overflowed their banks. Dayton, Indianapolis, Columbus, and numerous other smaller towns have suffered immensely during the last week of March and much loss of life has occurred. Hundreds of houses have been washed away, and immense suffering has been caused. At Louisville the river is said to have passed the level of the great flood of 1907. Fortunately the immense loss of life given in the earlier reports was somewhat exaggerated, and later estimates at the end of March give the total casualties in the stricken area as 500. The rivers are said to be still rising in many places, and the full result of the disaster will depend largely upon the weather for the next week or two.

We have received the first two monthly issues of *The O.S. Review, the Journal of the Organisation Society*. This society (which has offices at 15–16 Buckingham Street, Adelphi) aims at applying objective methods of analysis and presentation to the data upon which all social legislation and administrative activity upon the large scale must be based. This aim necessarily implies that the society must itself "be outside politics, parties, and every kind of movement" in order to become "a centre of authority and reference," the activities of which will tend to bridge the present "gap between legislation and fact," and to minimise the distorting effects of political bias. The two numbers of the review offer illustrations of the proposed methods of research and of the application of the society's cardinal principle that "society is an extension of the individual." The society has a branch—"the Andrological Institute"—the special function of which is to collect and analyse measurements of bodily organs and physical and mental functions. As an *exposé* of its aims and methods it has published an elaborately illustrated pamphlet which deals in particular with measurements of mental "perseveration."

The general meeting of the American Philosophical Society will be held in Philadelphia on April 17–19, when the president, Dr. W. W. Keen, will take the chair. A very varied programme will be provided, and it is possible here to refer to a few only of the numerous papers. These include:—"Interpretations of Brain Weight," Prof. H. H. Donaldson; "Heredity and Selection," Prof. W. E. Castle, of Harvard University; "The Nature of Sex and the Method of its Determination," Prof. C. E. McClung, of Pennsylvania University; "The Control of Typhoid Fever by Vaccination," Prof. M. P. Ravenel, University of Wisconsin; "New Spectroscopic Evidence for the Solvate Theory of Solution," Prof. H. C. Jones, Johns Hopkins University; "The Magnetic Field of the Sun," Dr. G. E. Hale, director of the Solar Observatory at Mount Wilson, Cal.; and "Progress of New Lunar Tables," Prof. E. W. Brown, Yale University. On the evening of April 18, Prof. G. G. MacCurdy, Yale University, will give an illustrated lecture on "The Antiquity of Man in the Light of Recent Discoveries." On April 19 a symposium on wireless telegraphy has been arranged, in which the following physicists will take part:—Dr. L. W. Austin, head of the U.S. Naval Radio-Telegraph Laboratory; Prof. G. W. Pierce, Harvard University; Prof. M. I. Pupin, Columbia University, N.Y.; and Prof. A. G. Webster, Clark University, Worcester.

The problem of the cooperation of museums with education is being seriously considered in America. In No. 3, vol. iii. of *The Museum Journal* we have a description of the means by which the museum is being made accessible and interesting to school children. The arrangement of the exhibits is geographical, and special attention is naturally paid to the large collections illustrating the life of the American Indian, his arts and industries. A native and his wife, of the Chilkat tribe, are employed on the museum staff, and, dressed in their national costume, take an active part in class-work, moving among the children, explaining the exhibits, and answering questions regarding them. This arrangement is described to be successful in promoting among the children an intelligent interest in the collections.

American ethnologists generally accept the view that the American native race did not originate in that continent, but that it is the result of a comparatively recent, post-glacial, immigration, and that the Indian, closely related to the yellow-brown peoples of eastern Asia and Polynesia, represents, in the main, a gradual overflow from north-eastern Siberia. To supply evidence in support of these conclusions, Dr. A. Hrdlicka, of the U.S. National Museum, has recently made an extensive tour in Siberia and Mongolia, the results of which are summarised in No. 16, vol. lx., of the Smithsonian Miscellaneous Collections. His inquiries tend to establish the origin of the American Indian from eastern Asia. Dr. Hrdlicka points out the immense archæological remains, in the shape of burial mounds, or Kourgans, which still await excavation in north-eastern Asia. When the scientific exploration of this region is systematically undertaken, much important material for the examination of American ethnological problems will certainly be provided.

In *Man* for March Mr. J. Edge-Partington, under the title of "A Note on Certain Obsolete Utensils in England," gives an account of a collection of old-world appliances, mostly connected with cooking and brewing, which have passed out of use. Mr. Digby-Wyatt, in his house, Weston-Corbett, Hants, has furnished an old room with a very interesting series of such utensils. Mr. Edge-Partington's collection includes all sorts of curious specimens—fire-dogs, pestles and mortars, bread shovels, gophering-irons, meat-jacks, pot-hooks, and "lazy backs," brewing appliances, and many other things of the same kind, which throw much light upon the domestic life and manners of our ancestors. It is surely time that the suggestion for the establishment of a museum of folk culture, to contain specimens of this kind, which are rapidly disappearing and soon can never again be brought together, was seriously considered.

The campaign against tuberculosis has advanced a further stage. A general order of the Local Government Board, extending the principle of compulsory notification to all forms of human tuberculosis came into force on February 1. A further order of the Board of Agriculture and Fisheries makes the notification compulsory of tuberculosis of the udder, indurated udder, and other chronic diseases of the udder, and of tuberculosis or apparent tuberculosis of any bovine animal. This order is to come in force on May 1. Animals found to be suffering from tuberculosis are to be slaughtered, and compensation will be given on a scale depending on the extent of the tuberculous disease.

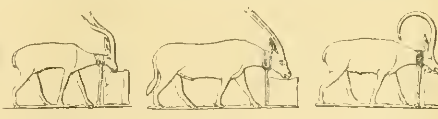
An appreciative memoir, accompanied by an excellent portrait, of Dr. E. A. Wilson, the naturalist to Capt. Scott's expedition, appears in the March number of *British Birds*, Dr. W. S. Bruce being the author; while the story of Wilson's life and work is sympathetically told by Dr. Shipley in the April number of *The Cornhill Magazine.*

A valuable report, by Mr. J. Johnstone, on some mussel beds in Lancashire and North Wales as regards their liability to sewage contamination has been issued by the Lancashire and Western Sea Fisheries District, under the direction of Prof. Herdman, F.R.S. The beds in several districts are found to be polluted. Mr. Johnstone, in his introduction, makes some interesting remarks on methods of examination and on "standards" from the statistical point of view.

We have to acknowledge the receipt of the fourth annual report—for the year ending March 31, 1912—of the Superintendent of Dominion Parks, Canada. It is there stated that the predictions made a few years ago "in regard to the mountain parks have been more than realised, and their development has already exceeded the most sanguine expectations. . . . Judging from past development and present indications, it is a difficult matter to estimate the limit of the usefulness of these mountain parks as unique pleasure and health resorts, not only for the Dominion, but for visitors and tourists from almost every part of the world." The report is profusely illustrated with photographs of striking scenery.

Additional evidence of the affinity of the Tertiary fauna of eastern Europe and western Asia to that of North America is afforded by Mr. E. Kiernick's description of a new species of Titanotherium from the neighbourhood of Prague, in *Bull. Ac. Cracovie* for December, 1912. The Titanotheres are essentially an American group of perissodactyle ungulates, but in 1876 a specimen from Transsylvania was referred to the family under the new generic term Brachydiastematherium, while in 1892 Prof. Toula referred a jaw from Rumelia to the American genus Menodus, as *M. rumelicus.* Some doubt has been thrown on the reference of the former to the Titanotheriidæ, but Mr. Kiernick considers that it is a member of that family, albeit of the aberrant group Palæosyopinæ. The Prague fossil, which consists of part of a lower jaw, with the last molar, is assigned to the typical genus, under the name of *Titanotherium bohemicum.*

From an interesting article by Dr. Claude Gaillard, of the Museum of Lyons, published in the *Revue d'Ethnographie et Sociologie,* Paris, 1912, Nos. 11 and 12, it appears that the ancient Egyptians were in the habit of keeping several of the wild ruminants



A B C

Dorcas gazelle (A), white oryx (B), and Nubian ibex (C) from the tomb of Mera at Sakkara. (After Gaillard.)

of north-eastern Africa in a state of semi-domestication for the purposes of the table. Among the species thus kept were the dorcas gazelle, the addax, the white oryx, and the Nubian ibex, representations of all of which are shown in a bas-relief in the tomb of Mera at Sakkara, dating from the sixth dynasty, in association with those of domesticated cattle and goats. That they were kept in a captive condition is indicated by the circumstance that in each case they are shown feeding out of a trough and haltered, and also by the prefix or the word *ran*, apparently indicating domestication, to their names.

THE January number of *The Quarterly Journal of Microscopical Science* (vol. lviii., part 3) again bears witness to the large amount of experimental investigation which is being carried on by biologists. The eggs and larvæ of sea-urchins afford material for no fewer than three papers by different writers. There is an interesting paper by the late G. H. Grosvenor, whose untimely death has inflicted a great loss upon zoological science, and Geoffrey Smith, on the life-cycle of the small fresh-water Crustacean, *Moina rectirostris*. These authors point out that, according to Weismann, sexual forms should be produced in every parthenogenetic generation independently of external conditions, but they actually find that by isolating the parthenogenetic females at birth until the production of the brood at a temperature of 25° to 30° C., the production of sexual forms is entirely suppressed. They conclude that the influence of isolation and of a high temperature on the suppression of the sexual forms may be ascribed either to the comparative absence of excretory matter or else to highly favourable nutritive conditions. Another memoir of special interest to students of animal bionomics is on stolon formation in the remarkable polychæte worm, Trypanosyllis, by F. A. Potts, which forms an important contribution to our knowledge of the very curious processes of asexual multiplication by budding that take place in this group. We must, however, enter a protest against the use of the term "stolon" for the reproductive individuals which arise by budding in such cases.

ALTHOUGH much work has been done in recent years on the bacteriological conditions in soils in temperate zones, there has been hitherto a scarcity of data relating to soils in tropical and subtropical countries. On this account a report of studies on Indian soils, by Mr. C. M. Hutchinson (Memoirs of the Department of Agriculture in India, Bacteriological Series, vol. i., No. 1), forms a welcome addition to the subject. Investigations have been undertaken with the view of testing the methods already in general use for the purpose of ascertaining their value under Indian conditions. The phenomena associated with the partial sterilisation of the soil, the occurrence of bacteriotoxins, and the rapidity of biochemical changes, such as ammonification, nitrification, and nitrogen fixation, have been subjected to a critical study. The view that the decomposition of cellulose is due chiefly to the activities of anaërobic organisms is perhaps given too much prominence in the discussion of the utilisation of organic residues.

MR. J. VAN BAREN, of the Landwirtschaftliche Hochschule in Wageningen, Holland, publishes in the *Compte rendu* of the eleventh International Geological Congress a paper on red stony loam as a product of interglacial weathering. He notes the occurrence of this material as isolated sheets in eastern Holland, overlain by Boulder Clay or Boulder Sand, and points out that the fragments of iron-bearing silicates in the red loam show, by their rusted condition, signs of atmospheric weathering. The small pebbles are also strikingly attacked, in distinction from those obtained from the sandy residue of the overlying Boulder Clay. The author urges that the Red Boulder Loam is decidedly older than the second series of glacial deposits above it, and that its weathered condition indicates exposure during an interglacial epoch. The analyses given do not support his contention that the products of weathering are lateritic. Comparisons are made with similar materials in north Germany, north Italy, the east coast of England, and the United States, and the desirability of chemical investigations of these is pointed out. In the discussion on the paper Mr. van Jentsch urged that a red colour in such deposits does not always imply a weathered condition.

WE have received a separate copy of the address given by Prof. J. von Kowalski to the Swiss Naturforschenden Gesellschaft at the Altdorf meeting last year. It deals with the relations between radiation and energy, and, after giving an account of the work of Wien and others, sketches the quanten theory as advanced by Planck, and stated with great clearness by Einstein in 1905. After showing how fertile the theory has been in suggesting new lines of research in both theory and experiment, the author emphasises the fact that at the present time the point of view provided by the theory is already known to be too restricted. Having served the true function of a theory—to indicate the line of advance—it must soon be replaced by some more general conception which will make clear to us those relations between matter and energy of which the quanten theory has given us a misty glimpse.

OBSERVATIONS on the seiches of Japanese lakes were begun in 1901, on the suggestion of Prof. Nagaoka. Four years later, the seiches of the nearly circular lake Toya, in the island of Hokkaido, were found by Prof. Honda to have a period of 9·29 minutes. In 1911, Mr. N. Mori found the period to be 4·5 minutes, and suggested that the mean depth of the lake had increased by about fifty metres during the interval of seven years. Mr. K. Sano shows, however, that the two periods may be the result of different modes of vibration if account be taken of the existence of the circular island in the middle of the lake (Journ. Meteor. Soc. of Japan, January). He finds that the period of the seiches would be 10·25 minutes if the water oscillate with a straight nodal line through the common centre of the lake and island; and 3·9 minutes if there were a circular nodal line midway between the boundaries of the island and lake.

A PAPER on measurement of the flow of the River Derwent, Derbyshire, by Mr. E. Sandeman, read before the Institution of Civil Engineers on April 1, contains snme interesting particulars. The flow of the river has been measured since 1905, when a weir was built by the Derwent Valley Water Board, to ascertain the yield from an area of about fifty square miles of the northern portion of the watershed. The area in question varies in elevation from 500 to 2060 ft. Rain-gauges to the number of forty-six were fixed on this area, being approximately 1 to each 700 acres. In the last thirteen years the recorded rainfall has averaged 46·34 in. The lowest rainfall of any of the gauges was 34 in., and the highest 61 in. The flows over the measuring weir are recorded on a rotating drum driven by clockwork with cam attachment. The highest flood on the drainage area occurred before the building of the weir. It was calculated to have reached a flow of 486 cu. ft. per sec. per 1000 acres from an area of 9321 acres. The minimum flow recorded was 0·29 cu. ft. per sec. per 1000 acres. Records of evaporation from a water surface 6 ft. square showed a variation from 10·25 in. in 1907 to 19·62 in. in the year 1911. The general result of the measurement of the rainfall and the yield of the river showed that the quantity of water collectable was—on the average of the seven years under consideration—equal to 75·2 per cent. of the rainfall.

Messrs. Longmans, Green and Co. have in preparation a series of monographs on physics, which will to some extent follow the lines of their monographs on biochemistry and on inorganic and physical chemistry. The editors of the physical series will be Sir J. J. Thomson, O.M., F.R.S., and Dr. F. Horton, of the Cavendish Laboratory, Cambridge. The first volume in the series will be "Rays of Positive Electricity," by Sir J. J. Thomson.

Messrs. Henry Sotheran and Co., 140 Strand, and 43 Piccadilly, London, have issued part viii., forming part iii. of the Supplement, of their "Bibliotheca Chemico-Mathematica." The catalogue not only contains an unusually complete collection of works on the exact sciences, including many old works of rarity and interest, but also on such kindred subjects as ballooning, horology, and meteorology. The net prices of the volumes are given in every case.

The classified list of Smithsonian publications, available for distribution on January 1 last, has been published by the Smithsonian Institution of Washington. The institution is able to supply papers only as an aid to the researches or studies in which applicants are especially interested. The papers included in this list are distributed gratis, except as otherwise indicated. Of the serial publications of the institution, the volumes of "Contributions to Knowledge" and of "Miscellaneous Collections" are distributed only to public libraries and to learned societies.

Messrs. J. and A. Churchill announce the following works for early publication:—"Liquid Air, Oxygen, and Nitrogen," by G. Claude, translated from the French by H. E. P. Cottrell; "The Examination of Waters and Water Supplies" (second edition), by Dr. J. C. Thresh; "A Laboratory Text-book of Chemistry," part i., by V. S. Bryant; vol. vii. of the new edition of "Allen's Commercial Organic Analysis," rewritten, under the editorship of W. A. Davis and S. S. Sadtler.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences for April:—

April 6. 5h. 33m. Sun eclipsed, invisible at Greenwich.
,, 12h. 0m. Jupiter at quadrature to the Sun.
8. 5h. 10m. Venus in conjunction with the Moon (Venus 4° 1′ N.).
9. 22h. 41m. Saturn in conjunction with the Moon (Saturn 6° 22′ S.).
20–22. Maximum of Lyrid meteors.
24. 14h. 0m. Venus in inferior conjunction with the Sun.
,, 17h. 0m. Mercury at greatest elongation W. of the Sun.
26. 2h. 13m. Jupiter in conjunction with the Moon (Jupiter 5° 9′ N.).
27. 16h. 24m. Uranus in conjunction with the Moon (Uranus 3° 52′ N.).
,, 21h. 0m. Uranus at quadrature to the Sun.

The Radial Velocity of α Persei.—Hnatek having recently published the conclusion that the radial velocity of α Persei varies in a period of 4·1 days, it appeared desirable to Mr. J. H. Pitman (Lick Observatory Bulletin 224) to undertake a comprehensive treatment of the subject based on all available observations. In addition to the many results already published by various authorities, the chief being the long series by Goos and Hnatek, the author has employed ten hitherto unpublished determinations. Six of these made during October, 1912, give a mean velocity of $-2·49 \pm 0·42$ km. per second. The discussion leads to the conclusion that the radial velocity of α Persei must be either constant or only minutely variable in a period still undetermined.

The Smithsonian Astrophysical Observatory.—The report on the operations of the Smithsonian Astrophysical Observatory for the year ending June 30, 1912, has been received. The director, Mr. C. G. Abbot, is to be congratulated on the success at last attending his persistent efforts to obtain a grant from Congress. This enabled simultaneous spectrobolometric determinations of the solar constant of radiation to be made at Bassour, Algeria, by the director, and at Mount Wilson by Assistant Aldrich, on twenty-nine days during August–November, 1911. The observations have not yet been completely reduced, but so far as the first half of September the values obtained at Bassour agree with those previously determined at Washington and Mount Whitney in indicating a local condition at Mount Wilson tending to make the results too small by about 2 per cent.

Further, it appears that high solar constant values obtained at Bassour coincide with high values at Mount Wilson, and *vice versâ*. This relation is exhibited in two diagrams; in the first the curves obtained by plotting the successive values at the two stations show a rough parallelism; in the second the simultaneous values are plotted, and instead of grouping round a centre they are seen to be strung out along a line. It is further stated that a solar variation of 4 per cent. was indicated at both stations. The importance of setting at rest the question of the variability of this fundamental factor in meteorology is thoroughly realised by the energetic director, who returned to Bassour last May to extend his former observations. Mr. Fowle had already commenced work at Mount Wilson in April. It is confidently anticipated that the combined results will be decisive. The solar constant work has received help from valuable results obtained by Mr. Fowle in continuation of the research on the absorption of radiation by water vapour. To him is due a spectrobolometric method of determining (within 1 or 2 per cent.) the total quantity of water vapour between the observer and the sun. This method should supersede the approximations based on psychrometric observations at different levels.

This observatory undertakes the fitting up, standardisation, and packing of the copies of the silver disc pyrheliometers supplied at cost price by the Smithsonian Institution. During the past year ten of these instruments were sent out, chiefly to Governmental meteorological stations.

THE SPECTROSCOPIC BINARY BD $-1°$ 943.—The star δ Orionis was found by Hartmann in 1904, to be a spectroscopic binary, but the K-line did not take part in the regular displacements of the other lines. The hypothesis he has put forward to explain this apparent anomaly is that the K-line was due to the absorption of a calcium cloud which lay between stars of this class and the solar system. In the *Astronomische Nachrichten*, No. 4633, Zaccheus Daniel informs us that a star the position of which is 5h. 28·9m. $-1°$ 13′, and was announced by Adams to be a spectroscopic binary, has a similar peculiarity to the one mentioned above. Its Harvard magnitude is 5·37, and its spectrum B2. Measurements of five, on the thirteen spectrograms secured at the Alleghany Observatory, of the best hydrogen and helium lines indicate a range in velocity of more than 200 km., a period of 3·05 days satisfying these velocities. Measurements of the K-line on eleven plates give velocities ranging from +5 to +25 km., the mean being +17 km. This value is nearly the same as that deduced by Hartmann from his measures of δ Orionis, which star is less than a degree from the binary under the above heading.

VARIABLE STAR CHARTS.—In the *Annales* of the Astronomical Observatory of Moscow, published under the direction of Prof. W. Ceraski (supplement to vol v., second series), Prof. Ceraski publishes a third series of thirty photographic charts of variable stars discovered by Madame L. Ceraski on the clichés of the observatory. The size of each chart represents eighty minutes of arc, and the charts are oriented after the Bonner Durchmusterung. The position of the variable is the centre of the plate, and is indicated by a small cross. Twelve of the variables represented are of the Algol type. The charts serve the very useful purpose of identification of the variables recorded, and are well reproduced.

EDUCATIONAL ORGANISATION IN AUSTRALIA.

TWO events which are certain to have great influence in the future development of education in Australia have recently taken place in New South Wales. One concerns the secondary schools of New South Wales, the other the University of Sydney. But in both cases their effects are sure to extend beyond the boundaries of the State to which they apply.

The first is that the Department of Public Instruction has introduced into New South Wales the system of intermediate and leaving certificates, as begun and carried out with success by the Scotch Education Department. An examination for the intermediate certificate has just taken place. Between 1500 and 2000 candidates presented themselves; but on this occasion the examination was only open to pupils of the State schools. At the close of next year the first complete leaving certificate examination will be held, and probably about 1000 candidates will come forward. That examination, and those in later years, will be open not only to the pupils of the State schools, but also to those of private secondary schools which have submitted to inspection, and have been placed upon the register as providing a satisfactory four-years' course of secondary education. A further increase in the number of State high schools is promised, both in the country towns and the city, and the number of candidates for the final examination is expected to grow rapidly in the next few years.

Written examinations enter only as part of the scheme. The candidates present themselves for the intermediate examination when they have completed an approved two-years' course in a secondary school; they come up for the leaving certificate examination when they have reached the end of an approved four-years' course.

In several minor matters the New South Wales system differs from that upon which it has been modelled, but to these one need not refer. One point, however, must be mentioned; to some it may seem an unnecessary alteration, to others a serious defect. The certificate of the Department of Public Instruction of New South Wales is to be granted on the recommendation of a board of examiners, appointed by the Governor. This board is to consist of four officers of the Department, and not fewer than four professors or other teachers of the University, nominated by the Senate of the University. In other words, the University of Sydney is associated with the Department of Public Instruction in the conduct of the examination.

To explain all the reasons for this association would take too long; nor is it necessary. It is chiefly due to the fact that until recent years the Departments of Public Instruction in the Australian States concerned themselves chiefly with primary education. For the most part secondary education was left to the private schools; or, as in Queensland, to grammar schools receiving a Government subsidy. In these circumstances the universities had organised a system of public examinations, somewhat after the pattern of the Oxford and Cambridge Locals. These public examinations had gained the confidence of the people and set a high standard of attainment. Of course, they had, and still have, some of the vices of all written examinations which are completely divorced from the school work and independent of inspection. But by accepting the cooperation of the University in the examination for the leaving certificate, the Department hopes not only to benefit by the service of skilled and independent examiners, but to graft upon the new system all that is best in the old.

The second event mentioned in the opening sentence is the more important, though it is not unconnected with the first. After prolonged debate, an Act entitled "The University (Amendment) Act, 1912," has been passed. In this Act provision is made for certain changes in the constitution of the governing body of the University of Sydney, and its endowment is materially increased. But these two objects were not the main reason for the introduction of the measure, nor was it either of these which principally attracted public attention. The vital principle of the Bill was that a large number of exhibitions were to be founded, entitling the holders to exemption from fees at the University, so long as they made satisfactory progress with their studies. A fixed number of these public exhibitions is to be allotted each year, the number having a definite ratio to the population. One exhibition is to be given for every 500 persons in the State between the ages of seventeen and twenty, as shown by the last preceding census. With the present population this works out at 200 per annum. If we take the length of the average course as four years, when the scheme is in full working order there should be 800 students at the University each year, for whom the State would pay.

At first it was intended that the exhibitions should be awarded only to holders of the leaving certificate. However, it was pointed out that in this way a deserving class would be deprived of the benefits of the measure. No exhibition could have been given to the man who desired to enter the University several years after he had left school; nor could one be gained by the lad who had been educated privately, or at a school below the standard required for registration. To remedy this defect, it was provided that, while the exhibitions were to be given each year on the results of the written examination for the leaving certificate, any person other than a candidate for the certificate, who had been a resident in New South Wales for three years, might compete at such examinations, and should be considered equally with the holders of the leaving certificate in the allotment of the exhibitions, except that the number given in any year to these persons should not exceed 5 per cent. of the total for that year.

For this measure the Labour Government of New South Wales is responsible. One of the planks in the policy of that party is free education from the school to the University; and one of the principles for which the party contends is equality of opportunity for the ablest pupils in the schools to advance further with their studies when they have proved their ability and industry. Free university education has not been pressed, but equal opportunity has been demanded, and this measure is meant to provide that opportunity.

The primary and secondary schools of New South Wales are already free; but to make the secondary schools free, and to provide also a large number of exhibitions exempting from fees at the University, is not sufficient to remove the obstacle in the way of an able boy or girl whose parents have only the most moderate means. For such cases additional assistance is required, and for them suitable provision has been made. Bursaries are to be granted to the best pupils of the elementary schools, assisting them, when they stand in need of such assistance, in their passage through the secondary school. On the successful completion of the secondary-school course, University bursaries are given by the State with a similar end in view.

The measure has been criticised in various quarters. Representatives of the professional classes spoke of the cheapening of the professions and of the lowering of the standard. But it was an easy task to answer these objections. The exhibitions are to be granted on the results of an examination in the regulations for which it is expressly provided that the subjects and standards shall be such as the University determines are necessary for matriculation. Also the University shares in the conduct of, and the responsibility for, the examination. The difference which this measure has made is that in New South Wales the boy whose parents cannot afford the fairly large expense of university education will not be cut off from the chance of gaining its benefits, if he proves himself to possess distinct ability and application.

The only serious vital criticism of the measure was that which pointed out that the increase of 10,000*l*. in the endowment of the University would not cover the ultimate loss it would suffer from the non-payment of fees and enable it to meet the other charges imposed upon it by the Bill. The University has, however, no real cause to be anxious on this account; it possesses the confidence of the people, and it is receiving each year largely increased sums of money on the Estimates. So far as this measure is concerned, Mr. Carmichael, the Minister for Education, to whom it is due, stated the situation in the Legislative Assembly as follows:—

"I have given my word on behalf of the Government that before 1916, when the University will receive the full flow of graduates, we shall increase the statutory endowment to meet the demands. I propose, if the Government has an opportunity—and, if not, I hope our successors will recognise the obligation—to raise the endowment in 1915 by another 10,000*l*. From the present day on to 1915 the University is to the good on this deal. I think we may fairly claim to have shown a liberality to the University which I hope our successors in office—if we do not remain here—will follow up. After 1915 the endowment will be increased to meet the requirements of the future."

It is now two years since the change of Government in New South Wales which for the first time gave the power into the hands of the Labour Party. These two years have been marked by great advances in the cause of education from the lowest to the highest level. To those who watch the evolution of democratic government in Australia it may be an interesting fact that, where the democratic tendency is most marked, the claims and advantages of the highest education have their strongest advocates and fullest recognition. New South Wales and Victoria have the advantage over the other Australian States which accompanies larger resources, a greater population, and further development. They have been able more thoroughly to undertake the work of school and university education, and so far as this State is concerned, it may be claimed that the leaders of the democracy, to whatever party they belong, have already abandoned the idea that the highest work can be done without the highest educational preparation for it.

H. S. CARSLAW.

RECENT WORK ON INVERTEBRATES.

THE *Entomologists' Monthly Magazine* for December, 1912, contains two beautifully coloured plates of Lepidoptera, illustrating new and rare species described by Messrs. Hamilton and Herbert Druce and Dr. T. A. Chapman.

In concluding, in the same issue, their notes on the British representatives of the leaping beetles of the genus Longitarsus, Messrs. Tomlin and Sharp direct attention to the apparently instable state of evolution of these beetles, some individuals of a species being winged, while others are apterous. This condition seems to point to the progressive disappearance of the wings in the group; and it is suggested that this may be due to the development of the saltatorial powers. Why it should be more advantageous to jump than to fly is not, however, very apparent, although it may be that the former mode of progression facilitates escape from enemies. A similar suggestion, it may be remembered, has been made in the case of the jumping Australian mice and rats, as compared with ordinary mice and rats, the leaping movement not improbably tending to baffle birds of prey.

In the second part of *Verh. Naturhist. Vereins der preuss. Rheinlande u. Westfalens for* 1911 (1912), Dr. C. Röttgen completes his long account of the beetles of Rheinland. In the same issue Dr. F. Haas discusses the geographical distribution of the west German Unionidæ, including extinct forms.

The manner in which spiders make their webs forms the subject of editorial notes in the December number of *The Country-Side*. It is stated that all the published accounts which have come under notice describe spiders as constructing their webs in narrowing circles from the periphery towards the centre; but first-hand evidence of the opposite mode of procedure (that is, working from the centre outwards) is cited, and the writer concludes that the published descriptions refer only to the repair of broken webs.

In the introduction to an elaborate monograph of the crinoids of the Indian Ocean, forming part 7 of "Echinoderma of the Indian Museum," published at Calcutta, Mr. A. H. Clark dwells on the extreme richness of the crinoid fauna of this area, which he regards as representing the stock that has given origin in the past to similar faunas in many other parts of the world. Nearly 400 Indian forms are now known, of which about 350 are comatulids and the remainder stalked types. They are arranged in nineteen families, with eighty-two genera, all the species being peculiar to the Indian region. The only family absent from this is the monogeneric Holopidæ. "All the genera of the Atlantic, Antarctic, and Arctic Oceans are closely related to East Indian genera, from which they were evidently derived in the remote past; but in many cases a single East Indian genus has apparently given rise to two or more Atlantic genera, all nearly equally related to the parent stock." It is also stated that crinoids may be utilised for obtaining an idea of the nature of the plankton of the seas in which they grow, thus affording a clue as to the suitability, or otherwise, of any given area for the support of food-fishes, sponges, coral, or pearl-oysters.

The fifth part of vol. x. of the Annals of the South African Museum is devoted to an account by the Rev. T. R. R. Stebbing of the local representatives of the group of small marine crustaceans known as Sympoda, or—if we follow the Cambridge Natural History—Cumacea. Although the members of the group are readily distinguishable from other crustaceans, their classification is a matter of difficulty, owing to the interlacing of characters and the existence of fine gradations. The author, who recognises a larger number of families than is adopted in the work cited, describes nine genera and fourteen species as new.

The pseudo-scorpions of the country form the subject of vol. x., part 4, of the Annals of the South African Museum. According to the author, the Rev. E. Ellingsen, less than half-a-dozen local representatives of the group were known at the beginning of the century, but the list is now very large, and has been increased in the article before us. The type genus, Chelifer, it is pointed out, will ere long have to be divided.

R. L.

FOAM STRUCTURE OF METALS.

In a paper on the "foam structure" of metals, in *The International Journal of Metallography* (iii., 1), Prof. Quincke gives a summary of the conclusions which he states as the result of researches dating from 1858 to the present day. While Prof. Quincke's views may well claim respectful consideration, his statement of them in the present paper is far from convincing, and his effort to extend to metals his theory of foam structure of matter appears to be singularly strained. To begin with, there is the fundamental assumption that before solidification commences even in a "pure" metal the liquid becomes heterogeneous, being divided into foam-cells by minute cell-walls differing in viscosity and surface-tension from the cell-contents. Quincke supposes these to be so minute that experimental evidence of their existence cannot be obtained, and he depends for the justification of his assumption upon the power of his theory to explain all the known phenomena of the structure and properties of metals. The present paper gives an outline of this explanation, but while it is distinctly ingenious it suffers from the defect that its author is obviously incompletely acquainted with the modern developments of metallography. As a result, one finds again and again that the proffered explanations are incompatible with well-established facts. One example, out of many which might be given, must suffice.

According to Quincke, the growth of crystals during annealing is due to the collapse of a foam-wall lying between two adjacent foam-cells, and forming what is usually termed an intercrystalline boundary, with the consequent coalescence of the two adjacent crystals into a single crystal. Direct observation of the process of crystal growth has, however, definitely shown that this is not the true *modus operandi*. The crystals do not grow by the bodily absorption of their neighbours, but by a process which may be likened to gradual invasion and conversion. The growing crystal gradually pushes its boundary outward into its neighbours, and frequently does so by pushing out one or more arms which gradually spread laterally as well as advance longitudinally. Nothing could be more unlike the picture suggested by Quincke's explanation, and similar difficulties can be raised at every turn.

On reading the paper, however, while those intimately acquainted with the behaviour of crystalline aggregates will scarcely be disposed to accept the "foam-cell" theory, they will yet be struck by the fact that the forces of surface-tension upon which Quincke lays such stress must powerfully affect the structure of metals and alloys—forces the importance of which has not perhaps been sufficiently recognised by current metallographic theories. In eutectic alloys particularly one constantly meets with structures which bear strikingly close resemblance to those assumed by films of liquid under the action of surface-tension. It has even been thought that the constituents of such eutectics may assume their actual forms just before solidification, in the shape of bags or sacks of the kind imagined by Quincke as foam-cells.

Experimental evidence is, however, against this view. The experiment has been tried of allowing eutectic alloys to solidify slowly under the action of centrifugal pressure in a powerful centrifuge, and the resulting structure is entirely unaffected. Had liquid sacks or "foam-cells" really been formed they must have been flattened or deformed under this treatment, but such was not the case. On the other hand, recent metallographic researches seem to indicate that the intercrystalline boundaries of a metal are of the nature of cell-walls formed by very thin layers of the same metal in the amorphous or undercooled liquid state, and here there is a decided approximation to Quincke's ideas, only that these cell-walls are regarded as the result of the meeting of adjacent growing crystals, and not as the primary limitations to crystal growth. Still, although Quincke's theory of foam-cells can scarcely be accepted as being in reasonable accordance with the known facts of metallography, a study of his views should be useful and suggestive to all those interested in the physics and physical chemistry of crystalline aggregates.

W. Rosenhain.

THE MELBOURNE MEETING OF THE AUSTRALASIAN ASSOCIATION.

THE Australasian Association for the Advancement of Science met at Melbourne, under the presidency of Prof. T. W. E. David, F.R.S., on January 7–14. The meeting proved most successful. There was a large and representative gathering of members from all the Australian States and New Zealand. Owing to the approaching visit of the British Association, it was decided to postpone the Hobart meeting, which in the ordinary course of events would have been fixed for 1915, until the beginning of 1916, and the cordial invitation, which the New Zealand delegates brought, that the succeeding meeting be in Wellington, was accepted.

The subject of the presidential address was "The Australian Climate, Past and Present," but before passing to it, Prof. David spoke of the interest the Federal Government had shown in scientific work relating to the Commonwealth. Its action in organising the recent scientific expedition to the northern territory, under Prof. Baldwin Spencer, and in arranging for his presence there for the last year, had commended itself both to the general public and to workers in science. The reports already published showed that the northern territory had far greater possibilities than most people had imagined, in regard both to its pastoral and mining features. The appointment of a man of science, Prof. Gilruth, to the important position of administrator was a step for which the association was grateful to the Government.

Papua also had not been neglected, and the mission of Mr. Carne to that country had been most successful. Among other things, he had located an extensive belt of oil-bearing sandstones, which he believed to be an extension of the great Burmese oil-belt, which ran through Sumatra, Borneo, and Java, to Timor, and thence to New Guinea. The oil-belt was full of possibilities, and he thought there was no more fascinating field for exploration than this island.

Dealing with the Australian climate, Prof. David spoke of the importance of the scientific observations of the Antarctic expeditions, especially those of Capt. Scott and Dr. Mawson. The meteorological data, communicated by wireless telegraphy from Macquarie Island by members of Mawson's expedition, showed most distinctly the association between the weather conditions of Australia and those of the subantarctic. It was to be hoped that in the near future some joint arrangement would be made between the Governments of Australia and New Zealand, providing for the continued upkeep of the station on that island.

From the evidence he had collected, he believed that the reason for the great climatic and biological differences between the north and south polar regions is mainly geographical; that it depends on the present distribution of land and water, and on the modifications which they introduce into the circulations of air and water in either hemisphere. The existence of the large continent of Antarctica, with an average elevation of about 6000 ft., acts as a great refrigerator in the southern hemisphere, and causes extremes, which otherwise would not exist, between the south polar and equatorial temperatures. This factor tends to increase the rapidity of air circulation in the southern hemisphere. It accounts for the periodic fierce outrushes of blizzard winds, which accompany the development of the Antarctic low-pressures, and often profoundly affect Australian weather conditions.

On the other hand, the absence of land in the north polar regions, and the presence of open water in the summer, cause the temperature in those regions to be much higher at that season in the Arctic than in the Antarctic.

In the course of his address, Prof. David made particular reference to the need for further development of the Department of Meteorology in Australia, and he stated that there was every prospect of the Federal Government making the Australian Solar Physics Observatory an accomplished fact in the near future.

A noteworthy feature of the meeting was a lecture on the northern territory and its aborigines, delivered in the Melbourne Town Hall, by Prof. Baldwin Spencer, who had just returned after a year's absence in the territory on a special mission from the Federal Government. The Governor-General and the Prime Minister were present, and the large hall was crowded long before the hour at which the lecture commenced.

Prof. Spencer began by a reference to the vastness of this part of Australia. It was four and a half times as large as Great Britain, but its population, excluding the aborigines, was less than 4000; and of the aborigines he did not think there were more than 40,000. The Commonwealth Government now had control of this region, and it had organised a series of important departments in which work of a valuable character was already being performed. It was necessary to remember that for forty years practically very little had been done in the territory. Now they had in their administrator a strong, straight, and fearless man, who had quickly won the complete trust and confidence of everyone working under him. The climate was undoubtedly trying, particularly in the wet season, which extends from March until September. But inland, on the "downs" country, it is infinitely better than on the coastal fringe. He believed that this cool winter climate would make a very great difference in the opening up, at any rate, of these inland regions, and the existence of these cooler temperatures at certain seasons of the year made the country differ from other tropical regions where such changed conditions were unknown.

Dealing with the natives, he was able to show the audience by kinematograph views and phonograph records some of the results of his investigations. A stay of about two months had been made on a station in the Alligator River district, and this time devoted wholly to acquiring information upon the habits, beliefs, and customs of the natives. He found these differed somewhat from those of the southern tribes.

A visit had also been paid to Melville Island, some forty miles from the mainland, which he reached in a small lugger from Port Darwin. The aborigines inhabiting that island were of a better type than those on the mainland. He saw ceremonies performed which were entirely new to him, notably a weird performance in connection with the burial of a man. A small plot of ground having been cleared of vegetation, a number of fantastic grave-posts were placed upright in the ground on either side of the prepared spot. Some fifty natives lined up, after the fashion of soldiers, whilst four other men ran between and around the grave-posts, stamping with their feet, which action was supposed to drive the spirit of the departed into the ground. Other films depicted the islanders in the canoes, in which they often negotiated the stretch of open ocean between the island and the mainland, forty miles across.

In his concluding remarks, Prof. Spencer said that the natives of the northern territory had certain attributes of a high character. Undoubtedly it was a great problem to know what to do with them; their entire lack of knowledge of agricultural methods rendered the problem all the more difficult of solution. He hoped very shortly to lay a scheme before the

Government whereby they would be in great reserves, protected from contaminating influences, and led to a higher and better life.

Many papers were communicated to the various sections, but limitations of space will not permit us to describe them. The presidents of sections and the subjects of their addresses, where this information has reached us, were as follows:—A, "The Relation between Pure and Applied Mathematics," Prof. H. S. Carslaw; B, Prof. C. Fawsitt; C, "The Evolution of the Physiographic Features of South Australia," Mr. W. Howchin; D, "The Present Aspect of Some Problems of Heredity," Prof. H. B. Kirk; F, Practical Aspects of Anthropology," Dr. W. Ramsay Smith; G, Observations regarding the Production and Distribution of Consumable Wealth and Economic Capital, with an Inquiry into the Probable Effect of Arbitrary Regulations of Minimum-wage Standards upon the Cost of Living; H, "A Review of the Existing Conditions of the Twin Professions of Engineering and Architecture in Australia"; K, "The Relation of Fertilisers to Soil Fertility," Mr. F. B. Guthrie.

A large number of reports received the approval of the general council of the association, but we can only refer to a few of them.

It was approved that a committee be appointed with instructions (*a*) to bring under the notice of the Federal Government the desirability of its providing for a re-determination of the difference of the longitudes of Singapore and Darwin, and of the differences of longitude of the Australian observatories from each other; (*b*) to communicate with the Indian Government with respect to the possibility of re-determining the difference between Madras and Singapore.

Prof. David brought up a recommendation that in view of the already proved importance to pure science, to weather forecasting, and to shipping, of the meteorological station and wireless installation at Macquarie Island, a committee be appointed with power to add to its number to take all steps necessary to maintain the station on a permanent basis. Macquarie Island is situated just half-way (*a*) between Australia and New Zealand, and (*b*) between both those countries and the Antarctic continent.

In the reports presented to the Glacial Research Committee, Prof. W. G. Woolnough records an extensive area of Permo-Carboniferous glacial beds discovered by him on the Manning River and the Macleay River, some 150 to 250 miles north of Sydney. The Boulder beds are associated with marine strata, and near Tane, on the Manning River, the more southern locality, the boulders are embedded in limestone. This occurrence is compared with the marine glacial beds of Jervis Bay, New South Wales. Mr. R. Speight summarises the results of recent investigations into the glaciation of New Zealand.

It was resolved that in view of the rapid decadence and disappearance of the Australian aborigines it is urgent that, in the interests of science, further records and collections, illustrative of the beliefs, customs, and manner of life of the aborigines should be made for public preservation, more especially with reference to Queensland and Western Australia. It was resolved also to take such steps as may be deemed necessary to enforce the existing law with regard to the exploration of anthropological material, and further to prevent the indiscriminate exportation of other anthropological and ethnological specimens from any part of the Commonwealth.

A committee was appointed to consider the best means of securing the efficient teaching of English pronunciation in Australasian universities, training colleges, and schools.

A committee appointed at the Sydney meeting, 1911, brought up a progress report on the steps to be taken with the view to the compilation of a list of the scientific serial periodical literature, both in public and private possession, in each of the principal cities of Australia.

REPORTS OF THE SMITHSONIAN INSTITUTION.[1]

The report of the secretary of the Smithsonian Institution for the year ending June 30, 1912, has been received from Washington. The general report reviews the affairs of the institution proper, with brief paragraphs relating to its several branches. The numerous appendices provide, in addition, detailed reports of the work—placed by Congress under the direction of the Board of Regents of the Smithsonian Institution—in the United States National Museum, the Bureau of American Ethnology, the National Zoological Park, and some four or five other organisations.

It is worthy of note that the total permanent fund of the institution amounts to 197,384*l.* The income for the year was 21,432*l.*, of which 11,675*l.* was interest on the permanent fund. The disbursements for the year amounted to 21,107*l.* More than this, the institution was responsible to Congress for the spending of the grants to the scientific organisations named above, and these reached a total of 148,400*l.*

The report of the Board of Regents consists of two main divisions: first, the annual report of the secretary, giving an account of the operations and conditions of the institution for the year ending June 30, 1911, and following the same general lines as the more recent report by the secretary dealt with above; and, secondly, the general appendix, comprising a selection of miscellaneous memoirs of interest, chiefly belonging to the year 1911, likely to be useful to men of science and others.

Among the original contributions to the general appendix is one by Mr. F. Alex. McDermott, of Washington, on recent advances in our knowledge of the production of light by living organisms; others are by Mr. N. C. Macnamara, on organic evolution: Darwinian and De Vriesian; by Mr. Paul C. Standley, on some useful native plants of New Mexico; and by Mr. William R. Maxon, on the tree ferns of North America.

Prof. A. M. Tozzer, of Harvard University, in a paper reprinted from the Proceedings of the American Antiquarian Society (Worcester, Mass., April, 1911), gives much interesting information concerning the value of ancient Mexican manuscripts in the study of the development of writing. These manuscripts, and those of Central America, constitute important examples of primitive ideas regarding art and illustration, as well as data of great ethnological value. The countries of Mexico and Central America are the only fields of the New World where any appreciable data on prehistoric life other than monuments, implements, and other objects are found. The manuscripts of Mexico are divided by Prof. Tozzer into two classes—those written before the advent of the Spaniards, and those written during early Spanish occupation.

Prof. Tozzer describes the manuscripts under discussion, and follows the development of writing from the period of reminders or mnemonics, to actual pictures, from them to a symbolistic and conventional

[1] Report of the Secretary of the Smithsonian Institution for the Year ending June 30, 1912. (Washington: Government Printing Office, 1912.) Annual Report of the Board of Regents of the Smithsonian Institution showing the Operations, Expenditures, and Condition of the Institution for the Year ending June 30, 1911. (Washington: Government Printing Office, 1912.)

ideographic system, thence to characters expressing sounds as well as ideas, and the beginning of syllaby, the first step in the development of phonetic writing. The Spanish priests made the last advance, in the form of an alphabet, by selecting syllabic characters to express initial sounds.

The volume is rich in translations, and among these may be mentioned an article by M. H. Marchand from *Cosmos*, on the invention of the gyroscopic compass and its practical utilisation on board ship; that by Dr. Jules Courmont, from the *Revue générale des Sciences*, on the sterilisation of drinking water by ultra-violet radiations; that by Dr. M. Philippot, in the "Annuaire Astronomique pour 1912," Belgium, on the legal time in various countries; that by Prof. S. Pozzi, from the *Revue scientifique*, on the garden of serpents, Butantan, Brazil; the translation from the German of Mr. W. Belck, in *Zeitschrift für Ethnologie*, under the title "The Discoveries of the Art of Iron Manufacture"; that of Mr. A. Lissauer's article, from the same German source, on the Kabyles of North Africa; and of Dr. A. F. Legendre's article in the *Revue de l'Ecole d'Anthropologie*, on the Lolos of Kientchang, western China.

Among the numerous reprints from English journals and magazines a small selection only can be given. We notice Sir David Prain's obituary notice of Sir Joseph Hooker, which appeared in NATURE for December 21, 1911. Numerous Royal Institution discourses are included, such as Commendatore Marconi's on radio-telegraphy; Prof. Wood's on recent experiments with invisible light; Prof. Richards's Faraday lecture on the fundamental properties of the elements; and Prof. H. S. Hele-Shaw's on travelling at high speeds on the surface of the earth and above it.

The addresses delivered at the meetings of the British Association also have been drawn upon, Sir William Ramsay's presidential address at the Portsmouth meeting being given a prominent place.

As usual, the illustrations are numerous and excellent.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SIR JOHN RAMSDEN has sent a subscription of 1000*l*. to the fund which Mr. Austen Chamberlain is raising for the extension of the London School of Tropical Medicine.

WE learn from *Science* that by the death of Mr. J. Lyman, Yale University will received 130,000*l*. He held the life interest in that sum, which was willed to the college by his brother, the late Mr. S. Lyman, who died in 1910. From the same source we find that both houses of the legislature of the State of Washington recently adopted the biennal budget. The University of Washington will receive a grant of some 201,000*l*. The matter of the replacement of the temporary university buildings by adequate modern structures has been submitted to the legislature separately. The recently adjourned legislature of West Virginia, too, voted larger grants to the State University than in any previous year.

A COPY of the programme of the Irish Training School of Domestic Economy for the session 1913–14 has been received from the Department of Agriculture and Technical Instruction for Ireland. The school is a residential institution, maintained by the Department for the purpose of training teachers of domestic economy, and also for providing a training in household management for girls who have already received a satisfactory general education. The school is situated at St. Kevin's Park, Kilmacud, Stillorgan, co. Dublin. The premises stand in grounds of about three acres. The house provides ample accommodation for the staff and students, in addition to class and recreation rooms. A large fruit and vegetable garden is attached to the house.

A NEW provincial technical college was opened at Workington, Cumberland, on Friday, March 14, by Sir John S. Randles, M.P., in the presence of a distinguished company. The college provides a complete course of day and evening training for students in engineering and metallurgy, serving especially the needs of the district. It is intended to commence day apprentice classes in connection with the local iron and steel works in September next. Inasmuch as the premises are used in the daytime for the accommodation of a day secondary school and a trade preparatory school, a complete scheme of education and instruction is provided. The school buildings comprise a block of twelve class-rooms, many specially fitted for the teaching of some specific subject, together with chemical, physical, mechanical, mining, and metallurgical laboratories, art-rooms, dining-hall, cookery-room, laundry, woodwork and metalwork shops, and the usual administration rooms. A gymnasium is in course of erection, and it is proposed to establish a hostel for boys and girls in order to overcome the usual geographical disabilities suffered by children in rural districts. The school generates its own electric current for lighting and power purposes, and a complete and elastic system of distribution has been arranged. Each class-room is fitted with a small table, with gas, water, and waste arranged, so that illustrative work may be carried out in any room; electric lanterns are also available in each class-room and laboratory. The building has been erected at a cost of nearly 30,000*l*. It is situated at the railway centre of west Cumberland, and already its accommodation is taxed to the utmost. There are well above 300 scholars in the daytime, and more than 500 evening students at present in attendance. The college is the only technical college in Cumberland, and it is financed out of county higher education funds. The staff numbers twenty full-time members. In opening the college, Sir John Randles (who had previously given a scholarship value 50*l*.) presented the governors with the sum of 1000*l*., the interest upon which was to be used in giving a student of the metallurgical department a travelling scholarship for the purpose of visiting metallurgical centres abroad.

THE International Kinematograph Exhibition and Conference was held at Olympia on March 22–29 inclusive, and aroused the keen attention of many distinguished people in various branches of knowledge. Though no advance in the general science of kinematography could be seen, there were many improvements of detail on view in machines, in films, and in pictures. Two kinematograph projector machines, shown by Messrs. Pathé Frères (one suitable for the class-room and the other for the theatre, both of which could be worked by being attached to the electric lighting current), represented one of the finest productions of mechanical art in every way. Their uses for educational means are further enhanced by the very great safety of using non-inflammable films and by the possibility of stopping the projector so as to display a still picture in case the teacher wished to describe or explain it. The pictures reflected great credit on the enterprise of the firms exhibiting, but except for one firm, already mentioned, no attempt had been made to produce pictures of direct educational bearing. The kinematograph trade would be well advised to consult educationists in order that its films may be produced with the requisite essential of scholarship and art, without which they may be only entertaining or useless or positively harmful. The Educational Conference, organised by Mr. A. P. Graves, was most successful. Addresses dealing with the various educational uses of the kinematograph were delivered by Canon Lyttleton, Mr. A. P. Graves, Miss Von Vyss, Dr. Sleight, Mr. F. W. Sanderson (headmaster, Oundle School), Mr. A. Burrell, Mr. Morley Dainow, Dr. Hayward, Prof. R. A. Gregory, and Miss Marsh. Amongst the chairmen were Sir A. K. Rollit, Dr. Kimmins, and Prof. Lyde. The discussions were vigorous, and many headmasters, teachers, doctors, civil servants, and representatives of educational organisations took part, while amongst the audience were two representatives of the Board of Education. The essence of the discussion was that the power of the kinematograph as an educational force is enormous. Every attempt should be made to guide and control it. Three important resolutions were passed embodying these views, and a committee was appointed to carry them out. The proceedings of the conference are being compiled by Mr. Morley Dainow.

Lord Haldane addressed a large joint meeting of secondary- and technical-school teachers on March 29 at the University of London. There is a notion in the head of the man in the street, said the Lord Chancellor, that secondary education is a luxury with which he need not trouble himself, and so long as that notion is in his head it will be very difficult to get him to pay any taxes for secondary education. But if it can be brought home to him that the state of the education question in this country is at this moment a peril to the nation and that it is a question of national safety with which we are dealing, then he will take a larger view. We are behind the level which has been reached by several of our competitors, a level which will put us in peril. We cannot dissociate national progress from the basis of knowledge even when it comes to the question of making money; and if the level of the national income is to be maintained, if our industrial pre-eminence is to stand, Lord Haldane said deliberately that the nation will have to make an effort to put its educational system in order. One reason why the universities have suffered is because we have never understood fully the significance in the educational system of the secondary school. In Germany it has been different. The whole educational fabric there rests upon the basis of the secondary school. The boy goes into the secondary school young, and remains there if he goes through the full course for about nine years, and at the end of that time he is so qualified that he goes straight to the university. There is no matriculation examination, but the student has to produce his entrance certificate showing that he has gone through the mill and has been in the atmosphere of the secondary school. We have, continued Lord Haldane, outgrown the period of the old-fashioned examination. What we want is a record, and everybody who goes to the university should have that record. The time has not yet come when we can deprive the external student of his chance of getting an external degree. It will come when people realise that the external degree means nothing comparable to the degree which is the hall-mark of having lived in the atmosphere of the university. Education is the greatest reform we can take in hand, and expenditure on education is productive expenditure which we are justified in making a sacrifice to incur.

SOCIETIES AND ACADEMIES.

London.

Physical Society, March 14.—Dr. A. Russell, vice-president, in the chair.—Dr. J. A. **Fleming**: (1) Some oscillograms of condenser discharges and a simple theory of coupled circuits. A short method for arriving at a formula for the time of free electrical oscillation of a leaky condenser in series with an inductive resistance, the oscillations being damped. The formulæ can be confirmed by oscillograms taken at low frequency with a Duddell oscillograph. (2) Some Braun kathode-ray tubes used as high-frequency oscillographs, and an electrostatic influence machine, giving a steady current of 300 to 350 microamperes for working them. The Braun tubes have electrostatic deflection plates in them and an embracing field coil for providing a longitudinal field to keep the kathode spot in a central position on the screen.—B. B. **Baker**: Stretching and breaking of sodium and potassium. Wires made of metallic sodium and potassium collapse when stretched, not to a point, as is the case with most plastic substances, but from two opposite sides only, into a chisel end. Wires made by running the metal, molten under oil, into a glass tube and allowing it to solidify, also showed, on extension, two sets of equidistant rings on their surface, each inclined at an angle of 45° to the axis, the rings of opposite sets touching along the line of greatest thinning and bisecting one another along the line at which no thinning takes place.—R. G. **Lunnon**: The latent heat of evaporation of steam from salt solutions. The experimental method was to supply a measurable quantity of heat electrically to the solution boiling inside a calorimeter. The steam from the inner vessel passed into a detachable condenser, which was weighed at intervals. The difference between the measured heat L, and l_T the known heat of evaporation of water, is the heat of solution Q; and the present results indicate that for salts of the same acid Q is proportional to the concentration.

Zoological Society, March 18.—Mr. E. G. B. Meade-Waldo, vice-president, in the chair.—Miss Edith E. **Bamford**: Variations in the skeleton of the pectoral fins of Polypterus. An examination had been made of the material brought back by Budgett from his West African expeditions, in order to account for the discrepancies which occur in the descriptions of the fins of Polypterus as given by different investigators. These discrepancies were found to be due to the very numerous variations in the fins and to the previous scarcity of material. A description is given of the variations found in the radials, mesopterygium, propterygium, metapterygium, and the distal cartilages, and their bearing on the different descriptions and the theories of other investigators is indicated.—Dr. H. H. **Stirrup**: A descriptive study of an Oligochæte worm of the family Enchytræidæ. A number of new and interesting observations were recorded, including an account of the structure and significance of the so-called "septal glands," which had been found to contain two definite anatomical components.—Dr. W. **Yorke**: The relationship of the big game of Africa to the spread of sleeping sickness. The author stated that sleeping sickness in Nyasaland and Rhodesia is due to a different parasite from that causing the disease in other parts of tropical Africa. In these countries the disease is transmitted by *Glossina morsitans* and not by *G. palpalis*. As *G. morsitans* is ubiquitous, and not limited in its distribution to water-courses, this fact has an important bearing on the measures that can be recommended with a view to prophylaxis.

Geological Society, March 19. Dr. Aubrey Strahan, F.R.S., president, in the chair.—B. **Thompson**: The geology of northern Peru: Tertiary and Quaternary beds. Some 600 square miles of territory in the westernmost part of South America, between the fourth and fifth degrees of south latitude, are dealt with. A great uplift and folding of the rocks took place in late Oligocene or early Miocene times, followed by a comparatively short terrestrial epoch. A subsequent depression allowed of the deposition of Miocene and possibly later beds. In recent ages the area has been spasmodically rising. The exposed rocks probably attain a thickness of 5000 ft. or more. Eight palæontological zones are established, and about 150 species of fossils are recorded. The origin of the petroleum is traced to animal organisms.—G. A. **Frost**: The internal cranial elements and foramina of *Dapedius granulatus*, from a specimen recently found in the lias at Charmouth. Owing to the envelopment of the skull and its pyritisation, the bones and interorbital septum are preserved in perfect condition. There is no foramen in the parasphenoid in front of the basipterygoid processes, as in Lepidotus. The basicranial canal differs from that in *Amia calva*, in its extension to the rear of the skull.

CALCUTTA.

Asiatic Society of Bengal, March 5.—F. W. **Edwards**: Tipulidæ and Culicidæ from the Lake of Tiberias and Damascus. Three species at least are new to science, one of them (the Uranotænia) being the first of its genus to be found within the Palæarctic region. The occurrence of *Conosia irrorata* makes a notable extension of the known range of this widely spread species.—F. H. **Gravely**: A preliminary account of a revised classification of Indo-Australian Passalidæ. The Passalidæ inhabiting the Indo-Australian region can conveniently be divided into six subfamilies. This necessitates a rearrangement of the recognised genera, and the erection of a new genus with *Tiberius kuwerti*, Arrow, as type.—J. S. **Gamble**: Materials for a flora of the Malayan Peninsula, No. 24.—Capt. R. B. Seymour **Sewell**: Notes on the biological work of the R.I.M.S. *Investigator* during the survey seasons 1910–11 and 1911–12.—E. **Ghose**: The internal anatomy of the blind prawn of Galilee (*Typhlocaris galilea*, Calm).—C. F. **Rousselet**: A note on Rotifers from Galilee. Recognisable specimens of four widely distributed species were found in a tow-netting taken on the surface of the Lake of Tiberias in October, 1912; while two sessile forms were reared in Calcutta in large numbers from dried mud from the bed of a small pool between Tiberias and Nazareth. One of these (*Occister socialis*, Weber), although widely distributed, is a rare species.—B. L. **Mukherji**: The identification of the Soma plant.—M. H. **Shastri**: The ancient civilisation of Bengal. The early inhabitants of Bengal were not Aryans, but a race known for their industry and commerce, colonisation, and philosophy. Buddhism took its rise on the borderland of the Aryan culture, and it owed more to eastern India than to western India.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part vii., for 1912, contains the following memoirs communicated to the society:—

January 13.—P. **Koebe**: Foundations of the continuity method in relation to conformable representation and uniformisation (preliminary considerations).

May 28.—W. **Voigt**: Electric and magnetic double refraction (ii.).

June 22.—L. E. J. **Brouwer**: The freedom from singularities of the modular manifold.—P. **Koebe**: A new method of conformable representation and uniformisation.—W. **Behrens** and E. **Hecke**: The rectilinear motion of Born's rigid electron.

July 6.—G. **Tamman**: The method of determining p-T-lines for the construction of phase diagrams.

August 22.—D. **Hilbert**: Foundations of the elementary theory of radiation.

October 26.—G. **Tamman**: The theory of polymorphism (in crystals).—W. **Voigt**: Electric and magnetic double refraction (iii.).

November 23.—F. **Körber**: The relations between the volume-surfaces of the isotropic and anisotropic phase, and the course of the neutral curve, $\Delta v = 0$.

December 7.—A. von **Koenen**: The geological relations of the southern Reinhard and Bram Forests, especially on the Münden-Blatt.

The supplement contains a long paper by L. Schlesinger on Gauss's memoirs on the theory of functions, being part iii. of the "Materials for a Scientific Biography of Gauss," collected by F. Klein and M. Brendel.

BOOKS RECEIVED.

The Story of the Forth. By H. M. Cadell. Pp. xvii+299+plates+maps. (Glasgow: J. MacLehose and Sons.) 16*s*. net.

Union of South Africa. Mines Department. Geological Survey. The Geology of the Country round Warmbaths and Nylstroom, including the Rooiberg Tinfields. By H. Kynaston and Dr. E. T. Mellor. With notes by Dr. W. A. Humphrey. Pp. 52. (Pretoria: Government Printing and Stationery Office.) 2*s*. 6*d*.

Planetologia. By Ing. E. Cortese. Pp. vii+387. (Milano: U. Hoepli.) 3 lire.

Einführung in die höhere Mathematik für Naturforscher und Aerzte. By Dr. J. Salpeter. Pp. xii+336. (Jena: G. Fischer.) 12 marks.

Memoirs of the Department of Agriculture in India. Veterinary Series. Vol. i., No. 1. Anaphyloxis in the Larger Animals. By Dr. J. D. E. Holmes. Pp. 86+iii plates. Vol. i., No. 2. Salvarsan in the Treatment of Surra in Horses, Dogs, and Rabbits. By Dr. J. D. E. Holmes. Pp. 89–148. (Calcutta: Thacker Spink and Co.) 2 rupees and 1.4 rupees respectively.

Government of India. Meteorological Department. Indian Weather Review, Annual Summary, 1911. Pp. 131–194+cccxxxviii–ccccii+vi plates. (Simla: Government Central Branch Press.) 3 rupees.

Thèses présentées a la Faculté des Sciences de Paris pour obtenir le Grade de Docteur ès Sciences Mathématiques. By J. Bosler. 1re Thèse: Sur les relations des Orages Magnétiques et des Phénomènes Solaires. 2e Thèse: Propositions données par la Faculté. Pp. iv+96. (Paris: Gauthier-Villars.)

List of North American Land Mammals in the U.S. National Museum, 1911. By G. S. Miller, jun. Pp. xiv+455. (Washington: Government Printing Office.)

Mind and Health. By Dr. E. E. Weaver. Pp. xv+500. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Ueber Zonenbildung in kolloidalen Medien. By Dr. E. Küster. Pp. x+111. (Jena: G. Fischer.) 4 marks.

Jahrbuch der drahtlosen Telegraphie und Telephonie. Edited by Dr. G. Eichhorn. Band vi., Heft 3–6. (Leipzig: J. A. Barth.)

Lessons on Elementary Hygiene and Sanitation, with Special Reference to the Tropics. By W. T. Prout. Third edition. Pp. xx+184. (London: J. and A. Churchill.) 2*s*. 6*d*. net.

Fauna Hawaiiensis, or the Zoology of the Sandwich (Hawaiian) Isles. Edited by D. Sharp, R. C. L. Perkins, and Prof. A. Forel. Vol i., parts 1 to 6. Vol. ii., parts 1 to 6. Vol. iii., parts 1 to 6. (Cambridge University Press.) Prices various.

Laboratory Text-Book of Chemistry. By V. S. Bryant. Part i. Pp. vii+246. (London: J. and A. Churchill.) 4*s.* net.

Modern Pumping and Hydraulic Machinery. By E. Butler. Pp. xvi+473. (London: C. Griffin and Co., Ltd.) 18*s.* net.

Vererbungslehre mit besonderer Berücksichtigung des Menschen. By Dr. L. Plate. Pp. xii+519+3 plates. (Leipzig: W. Engelmann.) 18 marks.

Genetics: an Introduction to the Study of Heredity. By Prof. H. E. Walter. Pp. xiv+272. (London: Macmillan and Co., Ltd.) 6*s.* 6*d.* net.

A School Algebra. By F. O. Lane and J. A. C. Lane. Pp. viii+333. (London: E. Arnold.) 3*s.* 6*d.*

Pond Life. By E. C. Ash. Pp. viii+94. (London and Edinburgh: T. C. and E. C. Jack.) 6*d.* net.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief. 38 to 40. (Jena: G. Fischer.) 2.50 marks each Lief.

Western Australia. Geological Survey. Bulletin No. 43. Petrological Contributions to the Geology of Western Australia. By R. A. Farquharson. Pp. 100+iv. Bulletin No. 47. The Mining Geology of the Kanowna Main Reef Line, Kanowna, North-East Coolgardie Goldfield. By T. Blatchford and J. T. Jutson. Pp. 106+3 maps+iv. (Perth, W.A.: F. W. Simpson.)

Elements of the Precision of Measurements and Graphical Methods. By Prof. H. M. Goodwin. Pp. 104. (London: Hill Publishing Co., Ltd.)

DIARY OF SOCIETIES.

THURSDAY, APRIL 3.

ROYAL INSTITUTION, at 3.—The Bridge into Life: Dr. E. Frankland Armstrong.

LINNEAN SOCIETY, at 8.—Some Forms of *Alchemilla vulgaris*: C. E. Salmon.—Report on H.M.S. *Sealark*, Calcarea: Prof. A. Dendy.—*Embia major*, sp. nov., from the Himalayas: Prof. A. D. Imms.—A Free-swimming Nauplioid Stage in Palinuris: Dr. J. D. F. Gilchrist.—The Classification of the Order Symphyla: R. S. Bagnall.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Further Discussion*: Some Effects of Superheating and Feed-water Heating on Locomotive Working: F. H. Trevithick and P. J. Cowan.

FRIDAY, APRIL 4.

ROYAL INSTITUTION, at 9.—The Spectroscope in Organic Chemistry: Dr. J. J. Dobbie.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of the Nottingham District: B. Smith.

SATURDAY, APRIL 5.

ESSEX FIELD CLUB (at Essex Museum, Stratford), at 6.—Fairy-flies (Mymaridæ) and their Hosts: F. Enock.

MONDAY, APRIL 7.

ROYAL SOCIETY OF ARTS, at 8.—Aëronautics: Prof. J. E. Petavel.

SOCIETY OF ENGINEERS, at 7.30.—The Status of Engineers and Engineering, with Special Reference to Consulting Engineers: W. Ransom.

ARISTOTELIAN SOCIETY, at 8.—Some Points in Kant's Transcendental Æsthetic: W. W. Carlile.

VICTORIA INSTITUTE, at 4.30.—*Discussion*: The Gunning Prize Essay read on March 17. *Opener*: Dr. J. W. Thirtle.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Production of Steel Sections and their Application in Engineering Structures: A. T. Walmisley.

TUESDAY, APRIL 8.

ROYAL INSTITUTION, at 3.—Recent Discoveries of Early Man: Dr. A. S. Woodward.

ZOOLOGICAL SOCIETY, at 8.30.—(1) A Collection of Fishes made by Prof. Francisco Fuentes at Easter Island; (2) A Revision of the Fishes of the Genus Kuhlia: C. Tate Regan.—The Affinities of *Canis antarcticus*: R. I. Pocock.—A Collection of Mammals from the Hebrides, Scotland: Major G. E. H. Barrett-Hamilton and M. A. C. Hinton.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Discovery of a Human Skeleton in a Brick-earth Deposit at Halling, Kent: W. H. Cook.—Description of Human Remains: Dr. A. Keith.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: The Yield of Various Catchment-Areas in Scotland: W. C. Reid.—Measurement of the Flow of the River Derwent, Derbyshire: E. Sandeman.—*Probable Paper*: Coastal Sand-travel near Madras Harbour: Sir F. J. E. Spring.

WEDNESDAY, APRIL 9.

ROYAL SOCIETY OF ARTS, at 8.—Electric Supply in London: F. Bailey.

AERONAUTICAL SOCIETY, at 8.30.—Propellers: W. O. Manning.

GEOLOGICAL SOCIETY, at 8.—The Variation of *Planorbis multiformis*, Brown: Dr. G. Hickling.—The Structure and Relationships of the Carbonicolæ: Miss M. Colley March.

THURSDAY, APRIL 10.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Various Inclinations of the Electrical Axis of the Human Heart: A. D. Waller.—The Nature of the Toxic Action of the Electric Discharge upon *Bacillus coli communis*: Prof. J. H. Priestley and R. C. Knight.—(1) Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. II. The Wild Game Strain; (2) Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. III. The Wild *Glossina morsitans* Strain; (3) Infectivity of *Glossina morsitans* in Nyasaland: Surg.-General Sir D. Bruce, Majors D. Harvey and A. E Hamerton, and Lady Bruce.

ROYAL INSTITUTION, at 3.—Colour in Flowers: Dr. E. Frankland Armstrong.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Self-synchronising Machines (Self-starting Synchronous Motors and Rotary Converters): Dr E. Rosenberg.

CONCRETE INSTITUTE, at 7.30.—Structural Engineering: E. F. Etchells.

FRIDAY, APRIL 11.

ROYAL INSTITUTION, at 9.—The Winds in the Free Air: C. J. P. Cave.

PHYSICAL SOCIETY, at 8.—Some Errors in Magnetic Testing Due to Elastic Strain: A. Campbell and H. C. Booth.—Note on Kathodic Spluttering: Dr. G. W. C. Kaye.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, APRIL 10, 1913.

THE HERITABLE RESULTS OF CHANGED NURTURE.

Das Problem der Vererbung "erworbener Eigenschaften." By R. Semon. Pp. viii + 203. (Leipzig: Wilhelm Engelmann, 1912.) Price 3.20 marks.

RETURNING to the much-discussed question of the transmission of acquired characters, Prof. Richard Semon goes over the whole ground. Conclusions—both affirmative and negative—have been based on certain sets of data, but all the facts must be faced if we are to form a sound judgment. This is indeed what many biologists have tried to do. The first chapter, which is historical, includes the commendable suggestion that it is time to stop using inexact terms like "Lamarckism," so often taken as synonymous with the theory of the transmission of acquired modifications. In the second chapter the author formulates the question at issue: A stimulus sets up an excitation in a parental body; the residual effect of this excitation is a change in the reaction-capacity (an "Engramm"); can we say that in favourable circumstances there results a change in the hereditary potency of the germ-cells, and of such a nature that the offspring show a change in the same direction as that exhibited in the parent?

Prof. Semon begins his survey of the evidence by considering language, acquired knowledge, and training; and while he does not claim to prove anything, he refers to cases which suggest that individual experience must count somehow. Why is it, for instance, that a young buzzard, taken from the nest, treats an adder quite differently from a grass-snake? Has experience not counted at all in the evolution of this inborn power of discrimination? The fourth chapter brings together numerous interesting cases which suggest the inheritance of engramms. Young acacias with an "inherited disposition" to a certain rhythm of sleeping and waking will, as it were, try to give expression to this in quite unnatural conditions of illumination and darkness. Braus has shown that if the fore-limb be removed from the larva of a Bombinator, the operculum still shows the thin area, usually with a small hole, through which the limb would press out if it were there. Is this not a reminiscence of a previously established "mechanomorphosis"? The degeneration of the eyes of cave animals, considered in detail and in connection with Kammerer's experiments on Proteus, point to a hereditary accumulation of the structural results of disuse and darkness. In regard to this and similar cases it appears to us to remain a question of interpretation. Which reading of the facts presents least difficulty?

Prof. Semon does not think that we should give up expecting a specific hereditary result of often-repeated injuries, and he refers, for instance, to Kammerer's experiment on the Ascidian, *Ciona intestinalis*, the siphons of which were cut off over and over again. In consequence of the stimulus, the length of the regenerated siphons was excessive, and the uninjured offspring had also excessively elongated siphons. We must, of course, hear more about this interesting case. The sixth chapter marshals the positive evidence which goes to show that parents much modified by peculiarities of nurture may have offspring changed in the same direction, although the peculiar nurture is no longer operative. The evidence includes recent observations on the acclimatisation of plants, Woltereck's experiments on the helmet of Daphnia, and Kammerer's striking work on salamanders and the nurse-frog.

The question then arises: How are the germ-cells affected? Prof. Tower was led by his well-known experiments on potato-beetles to the view that the environmental factors operated on the germ-cells without any induction from the unchanged soma of the parent. But Prof. Semon points out that an adult beetle could not be expected to show much external change, and argues that there is no escape from a theory of somatic induction, the various possible modes of which are carefully and acutely discussed. The author concludes that long-continued functional modifications may by somatic induction exert a specific effect on the germ-cells, and that certain environmental stimuli may also affect the germ-cells by somatic induction. The results depend on three variables: the nature, strength, and duration of the excitations, the general constitution of the organism, and the state of the germ-cells—susceptible or otherwise—at the time. Prof. Semon's latest presentation of the case for the heritability of somatogenic changes is a valuable contribution to ætiology, and one that must be reckoned with by all biologists. The book is written with force and clearness and in admirable scientific temper.

J. A. T.

THE WORK OF G. VON REICHENBACH.

Deutsches Museum Lebensbeschreibungen und Urkunden. Georg von Reichenbach. By Walther v. Dyck. Pp. iii + 140 + viii plates. (Munich: Deutsches Museum, 1912.)

DURING the last eight or nine years an extremely instructive and valuable collection illustrating the various sections of science and technology has been accumulated at the Deutsches Museum in Munich, and in 1910 the committee of direction decided to publish a series of biographies of men whose work has had a special bearing on these subjects. The first volume to appear deals with the life and work of Georg von Reichenbach, to whom many advances, not only in the construction of astronomical and surveying instruments, but also in engineering, were due. Born in 1771, his education was carried on not only in school, but also in the workshop with his father, where he showed remarkable mechanical aptitude. At the age of twenty he was sent to England to study mechanical engineering, and in the works of Boulton and Watts in Soho he spent some months working at engine construction. While in England he had not had an opportunity of seeing the works of the leading instrument makers, but availed himself of every opportunity to study this industry also. Ramsden, Troughton, Dollond, Cary and others then supplied the greater part of Europe with instruments of the highest grade, but on his return to Munich he founded workshops for constructing instruments of precision, and for accurately dividing circles.

In the latter part of the eighteenth century a large amount of surveying was done, and in 1801 a base-line 21·7 km. long was measured near Munich for the systematic survey of Bavaria, so that von Reichenbach found his opportunity. The work of Laplace, Gauss, Bessel and others introduced a great increase in the precision aimed at and attained, and Reichenbach successfully constructed theodolites for the Bavarian survey with circles up to twelve inches in diameter; he was acquainted with Ramsden's great 36-in. theodolite which was constructed for General Roy, but apparently preferred the smaller instrument.

Throughout his work Reichenbach adhered to the vernier in preference to the micrometer microscope for astronomical as well as for geodetic instruments on the ground that with the former the portion of the circle was directly measured, while the micrometer measured the enlarged figure of the divisions. The circle of his 12-in. theodolite for the Bavarian survey was divided to five minutes and was read by a vernier to four seconds and by estimation to two. The triangulation of northern Bavaria called for the construction of a base-measuring apparatus, and in 1807 von Reichenbach constructed one consisting of iron 4-metre bars to be placed almost in contact, the interval being measured by a thin graduated wedge.

Large astronomical instruments were also constructed for Naples, Genoa, Turin, Mannheim and elsewhere, and are described as being among the best of that time. A very fine range of instruments, both astronomical and geodetic, is included in the collections of the Deutsches Museum. But, as Gauss remarked in a letter written to Bessel from Munich, the construction of astronomical instruments was not von Reichenbach's principal occupation.

Engineering machinery took up more of his time and attention, and in 1808 he constructed water-pressure pumping engines for the salt-works of Riechenhall and Traunstein, and others of improved design were built, and one of these, at Ilsauk, is still working. Iron-bridge construction and steam-engine design and construction also engaged his attention, and in many spheres of activity von Reichenbach showed remarkable originality and brilliant capacity. His family has presented to the Deutsches Museum a large collection of writings, drawings and plans, which have been extensively utilised in the present monograph, wherein Dr. W. von Dyck has produced not only a highly interesting account of a man of exceptional ability and resource, but has also rendered available a large collection of valuable and important documents relating to the construction of instruments of precision and of machinery, and some of these are reproduced in the plates which illustrate the monograph.

PURE AND APPLIED CHEMISTRY.

(1) *Chemistry of the Oil Industries.* By J. E. Southcombe. Pp. ix + 204. (London: Constable and Company, Ltd., 1913.) Price 7*s.* 6*d.*

(2) *Achievements of Chemical Science.* By Dr. J. C. Philip. Pp. vii + 217. (London: Macmillan and Co., Ltd., 1913.) Price 1*s.* 6*d.*

(3) *Le Celluloïd et ses Succedanés.* By W. Main. Pp. 162. (Paris: Gauthier-Villars, 1913.) Price 2.50 fr.

(4) *Ausführing qualitativer Analysen.* By Wilhelm Bilz. Pp. xi + 139. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1913.)

(1) THIS work fulfils in a very satisfactory manner the author's attempt "to fill a gap between the elementary text-books of organic chemistry and the numerous technical treatises and monographs of a highly specialised character." The opening chapter on the chemistry of the hydrocarbons and their derivatives will facilitate the reading of later sections by those not very conversant with organic chemistry, but, in the interest of these readers, exception must be taken to the use of the expression "rests," in reference to unsaturated groups or complexes (pp. 14–15). The adoption of this Germanism is quite unwarranted, inasmuch as the idea can

be accurately expressed in ordinary chemical English.

The next chapter contains much interesting matter concerning the origin and chemical nature of mineral oils, and the principles underlying the commercial methods of oil-refining. Under the heading of saponifiable oils and fats a very judicious selection has been made of the most important members of a very large group of substances derived from both animal and vegetable sources. The analytical methods employed in testing these materials are briefly described, and in several instances illustrations are given of the apparatus employed. The industrial applications of fats and oils are classified, special attention being paid to the various commercial processes of hydrolysis, and to the purification of the higher fatty acids by distillation in superheated steam.

In the section devoted to soap and candle manufacture the author shows how the phase rule and recent discoveries in colloid chemistry can be applied to elucidate the reactions of the soap-pan. Reference is also made to the part played by adsorption complexes in the detergent action of soap.

Looking to the future, the production of petroleum motor spirit by the thermal decomposition of heavier hydrocarbons is suggested as a promising problem for research.

(2) The present volume is one of a series of "Readable Books in Natural Knowledge," the author's theme being the usefulness of the chemist to the community. It is to be hoped that this work will assist in dispelling the deplorable ignorance still existing in the minds of many of the British public in regard to the nature and scope of the chemist's activities. Although on the Continent the difference between "chemiker" and "apotheker" or between "chimiste" and "pharmacien" is well understood, in the United Kingdom the chemist is still usually assumed to be a person who of necessity trades behind a window ornamented with large bottles containing various coloured solutions.

After referring to the work of the pioneers of modern chemistry, the subject of combustion is discussed with the object of showing that this typical chemical change includes not only the burning of ordinary combustibles, but also such phenomena as fermentation, the rusting of metals, and the drying of certain oils. In this connection alone the chemist may with advantage be consulted by the farmer, the coal exporter, the cloth manufacturer and other industrial workers in regard to difficulties arising in the ordinary course of their avocations.

The irrational mode of domestic heating with smoky coal leads the author to recommend "coalite" (semi-coke) or gas-fires. A human note is touched by the remark that the latter are regarded with disfavour because they cannot be poked and nothing can be thrown into them. A more serious objection to gas-fires is suggested under the heading of secondary fuels, namely, the grave risk of poisoning arising from faulty gas-fitting and the high percentage of poisonous carbon monoxide present in modern illuminating gas.

The achievements of inorganic synthetic chemistry receive adequate attention. It is pointed out that by a curious coincidence the year 1828 witnessed not only the synthesis of urea, but also the successful manufacture of artificial ultramarine. The natural pigment from lapis lazuli, which was once worth its weight in gold, is now replaced by the synthetic product sold at less than thirty shillings a hundredweight.

The admirable detective work performed by the analytical chemist in bringing to justice the sophisticator of food is noted with the appreciation which this public service deserves.

(3) This volume, which forms one of a comprehensive series of scientific pocket-books, gives a summary of the manufacture of nitrocellulose and its conversion into celluloid by means of camphor and other adjuvants. The inflammability of this material, which is now employed on an enormous scale in the production of cinematograph films, has led to many processes having for their object the preparation of non-inflammable celluloid substitutes. Viscose (an alkaline solution of viscoid) is now manufactured from wood pulp, soda ley, and carbon bisulphide. Acetocellulose, the product of the acetylation of cellulose, has been placed on a commercial basis in the Elberfeld colour works, after seven years of research. Galalite, prepared by precipitating casein with formaldehyde, can be obtained in a transparent condition by first removing mineral salts from the casein by successive treatment with alkalis and acids. The condensation products of phenol and formaldehyde, when indurated to the desired extent by heating under pressure, give rise to the valuable plastic material "baekelite." The work is of interest as showing the extent to which the celluloid industry has developed in France.

(4) Although this guide to qualitative analysis contains a certain amount of useful information, the matter is not arranged in such a way that it can be readily followed. The group reactions, for example, would be more easily grasped if given in tabular form. Very little attempt is

made to furnish theoretical explanations of the various analytical reactions. A few practical details may be quoted as illustrating modern tendencies in laboratory practice. The difficulty of separating nickel and cobalt is overcome by using dimethylglyoxime to precipitate the former metal, whilst the latter is identified in an ethereal extract with ammonium thiocyanate. There is a reversion to an old process in the removal of phosphoric acid from the precipitable metals by means of tin and nitric acid. Absolute alcohol is used to remove calcium nitrate from the mixed nitrates of the alkaline earths. G. T. M.

THE FLOW OF SUBTERRANEAN WATERS.

Le Principe du Mouvement des Eaux Souterraines. By J. Versluys. Traduit du hollandais par F. Dassesse. Pp. 147. (Amsterdam: W. Versluys, 1912.) Price 7 francs.

CALCULATIONS concerning the flow of subterranean water have almost invariably hitherto been based upon the classical law of Darcy, published in 1856—a law which states that the quantity discharged is directly proportional to the head, and inversely proportional to the thickness of the stratum traversed. The terms are simple, and, for general purposes, are sufficiently close approximations to the truth.

It has been demonstrated more than once that the "law" is not absolutely exact, and, in several cases, the divergency from experimental results has been considerable. The law, in fact, has manifest limitations. Darcy omits all reference to temperature, and, indeed, it is doubtful whether he was acquainted with the experiments of Poiseuille, although these had been published ten years earlier, in 1846. The results obtained by Poiseuille led that investigator to conclude that the mean velocity of the fluid depended, in part, on its specific gravity and also on the temperature.

The object of the author of the brochure before us has been to review the situation in the light of recent research, as exemplified by the work of King, Richert, and others. He investigates, in the first instance, the purely theoretical problem of water-flow in its most general form. Then the various numerical results published in the literature of the subject are collated in a form suitable for comparison with the calculated results, and where pronounced divergences occur, observations and explanations are furnished. Finally, for strictly practical purposes, the author gives a series of numerical coefficients for use in cases where merely general approximations will serve.

The book consists of thirteen chapters and is a most painstaking and valuable compilation of the data at present available on the subject.

OUR BOOKSHELF.

Das Relativitätsprinzip. Zweite vermehrte Auflage. By Dr. M. Laue. Pp. xii+272. (Braunschweig: F. Vieweg und Sohn, 1913.) Price 8 marks.

THE second edition of Prof. M. Laue's book on relativity, though on the same plan as the first edition of 1911, contains several additions. In chapter ii. a short discussion of a second arrangement of the Röntgen-Eichenwald experiments is inserted. The kinematic part of the theory of relativity, chapter iii., shows some slight explanatory extensions in § 6, and an enlarged discussion of the inadmissibility of propagation of any physical effects with a velocity exceeding that of light (§ 7). The "cause and effect" point of view here adopted, which leads to a rejection of any hypervelocity of propagation, seems somewhat too narrow. At any rate, it prevented the author from considering the admirable researches on relativistically rigid bodies of M. Born, and especially of Herglotz. In § 8 we remark a fuller exposition and illustration of the notion of "proper time."

In chapter iv. the vector product of two six-vectors and the four-dimensional "Gauss theorem" are inserted. Chapter v. contains, besides a few minor additions, a considerably extended treatment of the theory of the Trouton and Noble experiment, and a much amplified exposition of four-dimensional potential-theory, following the lines of a paper by Sommerfeld. Chap. vi. contains but a few new lines (on pp. 148–164), while vii. (Dynamics) contains many changes and ample additions, viz., Minkowski's dynamics of a point-mass, remarks on the foundations of the dynamics of continuous bodies (§ 27), and the rotational momentum, with a pair of instructive examples, several minor additions in the following paragraphs, and finally the chief addition to the first edition, namely, relativistic hydrodynamics, giving the general equations of motion, and treating the interesting special case of fluids "of smallest compressibility," both essentially on the lines of a paper by Dr. E. Lamla (*Ann. d. Phys.*, vol. xxxvii., p. 772, 1912).

The Dictionary of Entomology. By N. K. Jardine. Pp. ix+259. (London: West, Newman and Co.) Price 6s. net.

THIS useful compilation is a glossary of the technical terms used in describing the structure of insects throughout their several stages. Within the limits which the author has imposed on himself it is likely to be of much service to students of entomology. These limits, it is true, are somewhat narrow; there is no mention of individual species of insects, or of genera or families. The orders, when given, are defined in the briefest possible manner, and frequently there is no indication of the insects comprised in them. The words "Coleoptera" and "Lepidoptera" find a place, but there is no mention of Dermaptera, Odonata, Homoptera, or Heteroptera. Hemiptera and Neuroptera are given, but beyond a bare definition there is nothing to show their content. Some of the terms used in insect bionomics might have been included without greatly adding to the bulk of the work; these are not exclusively applicable to insects, but it is in entomological literature that they are chiefly to be met with. It might also have been well to add references in the case of the less usual terms.

The derivations will be welcomed by many; they are sometimes omitted, as under "coenogonous." Two incompatible derivations are given for "caterpillar," but the author does not help us to decide between them. A few misprints may be noted; "carneous" for "corneous," under "cranium"; "unbra" for "umbra"; "tergum," under "anal angle," probably for "termen," though the latter is insufficiently explained. Other slips occur, but on the whole the book is well suited for its purpose.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

Antarctic Barometric Pressure.

The reduction of the barometric readings taken during the first year of Capt. Scott's Antarctic expedition has shown what I imagine to be an unprecedented rise of barometer from one month to the next. The mean barometer during November was higher than during October by 0·81 in. at Cape Evans, 0·80 in. at Cape Adare, and 0·87 in. at the Norwegian winter quarters. The rise continued into the next month, and the mean value at all three stations for December was approximately one inch higher than that for October.

The instability of the atmosphere shown by such a change has a melancholy interest in view of the sad disaster caused by the weather, and is further of great meteorological importance. I should therefore be grateful for any information of similar large changes, so that they may be considered in my discussion of the meteorological results of the expedition.

The following table gives the mean height of the barometer at the three stations. The data have been reduced to sea-level and normal temperature and gravity. The large difference between the mean values at Framheim and Cape Evans is being investigated.

	Framheim	Cape Evans	Cape Adare
Lat.	78° 38′ S.	77° 35′ S.	71° 27′ S.
Long.	195° 30′ E.	166° 33′ E.	170° 15′ E.
1911			
February	—	29·31	—
March	—	29·21	29·12
April	29·08	29·32	29·25
May	29·02	29·23	29·05
June	28·88	29·11	29·11
July	28·86	29·08	29.01
August	28·94	29·19	29·06
September	28·90	29·16	28·98
October	28·61	28·82	28·76
November	29·49	29 63	29·56
December	29·66	29·75	29·72
1912			
January	29·36	29·43	—

George C. Simpson.

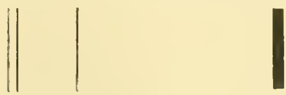
Simla, March 20.

X-Ray Spectra.

We have recently been carrying out some experiments with the object of finding whether spectra of heterogeneous beams of X-rays can be obtained by letting the rays fall on a crystal surface which would serve as a diffraction grating.

A beam of rays from a Röntgen bulb was directed on to the cleavage surface of a crystal of selenite at almost grazing incidence, the beam being made practically parallel by means of suitable lead stops. All the photographs taken of the reflected beam show exceedingly well-defined lines, which are not equally spaced, their number and distances apart varying according to the particular bulb used. These lines are parallel to each other and to the slit. The hardness of the bulb affects the relative intensity of the lines, but apparently makes no difference to their relative positions. Using the same bulb, crystals of different thicknesses all give the same lines.

The accompanying figure represents diagrammatically the lines obtained in one of the photographs. The direct beam strikes the plate at x, and in the reflected beam are seen three well-defined lines, x_1, x_2, and x_3 (in addition to what appear to be interference bands, not shown in the figure). When the bulb was



soft the line x_1 was very intense, whilst the other two lines were comparatively faint. Another photograph taken with the same bulb after it had been hardened shows the line x_1 very much less intense than formerly, whilst the lines x_2 and x_3 have increased in intensity. It appears, therefore, that the line x_1 is due to the softer constituents of the beam, and the lines x_2 and x_3 are due to the harder constituents. That is to say, the rays of longer wave-length are less deviated than the rays of shorter wave-length.

The results suggest that the lines obtained may be spectral lines in the spectra of the beams emitted from the respective bulbs. Further experiments are being carried on.

E. A. Owen.
G. G. Blake.

Teddington, Middlesex, April 7.

X-Rays and Crystals.

On repeating the experiments of Laue, Friedrichs, and Knipping on the transmission of X-rays through crystals, I have found that the transmitted rays may easily be made visible by means of an ordinary fluorescent screen, if we use a sufficiently large pencil of rays, and the crystals are sufficiently transparent to the incident ray.

The X-ray tube used was a Müller-tube of 20 cm. diameter, with water-cooling; the current was supplied by a Toepler influence machine with sixty plates. The diameter of the pencil of rays was 0·5–1·0 cm. The crystals examined were borax, alum, mica, fluorspar, rock-salt, rock-crystal, cane-sugar, &c., the thickness varying from 4 mm. to 1 cm. The transmitted rays show numerous detached fluorescent spots of elongated shape. If we rotate the crystal about an axis perpendicular to the incident ray, the spots move generally across the central spot caused by the incident ray, but we may choose the axis of rotation such that some of these spots remain stationary while the crystal is rotated.

Groups of detached pencils are arranged, as it were, on circular cones, which always touch the incident pencil, and the aperture of which varies continuously with the inclination of the crystal. With a plate of mica, a spot was observed which is situated as if it were the reflected image of the incident ray; but it is doubtful whether we may call it "reflected," because other spots are also seen on the same side of the plate, deviating considerably from the "image." Further experiments in this direction are in progress.

T. TERADA.

Physical Institute, Imperial University, Tokyo, March 18.

Fish-eating Habits of a Spider.

IN a lecture delivered to the Natal Scientific Society on November 22, 1911, the Rev. N. Abraham dedescribed the habits of a spider that he had observed catching and eating fishes. An account of the lecture was printed in *The Natal Advertiser* and subsequently reprinted in *The Agricultural Journal of the Union of South Africa,* but, so far as I am aware, these interesting observations have not appeared in any prominent scientific publication.

When Mr. Abraham's lecture was given the spiders had not been determined, but I have since had an opportunity of examining two preserved examples in his possession, and I have determined them as *Thalassius spenceri,* Picard-Cambridge (Proceedings of the Zoological Society, 1898, p. 28).

The following is an extract from the newspaper account:—"In the year 1905 I was living in Greytown, Natal. One day I was catching small fish and aquatic insects for an aquarium. I was using a small net in a shallow stream. I happened to see on the edge of the water a fine spider, which I captured. On reaching home I placed my specimen in a large aquarium, where I had a number of small fish. The spider measured about three inches when its legs were extended; the body is small, but the legs are long. After being on the rockwork of the aquarium for some time, it took up a very interesting position. It rested two legs on a stone, the other six rested on the water, well spread out, the ends of the six legs commanding a definite and well-defined area of water.

"Being busy, I merely took a note of its attitude, and left it to its devices. After a few minutes my servant boy came into my study to say that the spider I had put into the aquarium was eating one of my pet fish. I at once went to see what had happened, and soon saw the spider on top of the rockwork, holding in its grip a beautiful little fish about four times the weight of its captor. For a moment I was startled into a strange surprise. How could this spider, which has no power to swim, catch a lively, quick-swimming fish? I looked at it in wonder, as it seemed to clutch the fish as a cat clutches a mouse. It soon began to devour its catch, and after some time had passed nothing was left of the fish but its backbone. The spider had eaten it as surely as an otter eats its trout.

"I was now anxious to find out how the spider caught the fish. That night, about 11 o'clock, when I had finished my day's work, I sat down by the aquarium to watch the spider, with the hope that I might see how the fisherman caught his fish. The spider had taken up a position on a piece of stone, where the water was not deep, and had thrown out its long legs over the water, upon which their extremities rested, making little depressions on the surface, but not breaking the 'water skin.' The tarsi of two posterior legs firmly held on to a piece of rock just above water-level, the whole of the body was well over the water, the head being in about the centre of the cordon of legs, and very near to the surface of the water.

"After watching for some little time, I saw a small fish swim towards the stone and pass under the outstretched legs of the spider. The spider made a swift and sudden plunge. Its long legs, head, and body went entirely under the water, the legs were thrown round the fish with wonderful rapidity, and in a moment the powerful fangs were piercing the body of the fish. The spider at once brought its catch to the rocks, and began without delay to eat it. Slowly, but surely, the fish began to disappear, and after the lapse of some time the repast was over."

Recently the Rev. Father Pascalis Boneberg, of the Marianhill Monastery, Natal, has added to Mr. Abraham's observations. Father Boneberg has seen examples of this same spider catching and devouring tadpoles of the toad *Bufo carens,* and adults of the little frog *Rappia marmorata.* It is his intention, I understand, to communicate an account of his observations to a German scientific publication shortly.

That the observations of both these gentlemen are based upon the same species, *Thalassius spenceri,* I have no doubt, for Father Boneberg allowed me to examine an adult male and female, and two immature examples, of his spider. The two latter specimens he kindly presented to the Durban Museum.

E. C. CHUBB.

Durban Museum, Natal, March 15.

A Detonating Daylight Fireball.

THE following may be of interest to some of your readers. On the morning of February 10, at about 6 a.m., the manager and some of the employees of a sheep farm which is situated on the Coyle River, about seventy miles from its mouth, were working close to the settlement when they were suddenly startled by an almost deafening noise which resembled the explosion of a huge gun or a violent peal of thunder close at hand. This was followed by a humming sound, such as would be produced by a motor-car, which lasted for about twenty seconds, after which interval there was another explosion, less violent than the first, which in turn was followed by further hummings and explosions, the latter gradually dying away in about a minute or so.

These men saw nothing to account for the sound, but as the settlement is situated at the foot of a high hill, which rises to the south, it was their impression that the noise came from over the top of this hill. Later in the day Mr. Welsh, the manager referred to, from whom I had most of the facts, met some carters, who told him that they actually saw the object, that it was about twenty-five miles further down along the same river on the top of the high pampa at the same hour, that it resembled a huge ball of fire with a long tail behind, and passed rapidly from east to west; they noticed no explosion.

These facts were corroborated by a sheep farmer (Mr. Ness), who lives about twenty-eight miles above Mr. Welsh, on the same river. Mr. Ness told me that he did not see the object, but that the sound of the explosion shook all the windows in his house and was followed by the same humming sound and secondary shocks.

The servant of a neighbour in this town also informs me that on the same morning at about the same hour she heard what she considered a series of bombs exploding. Now Mr. Ness's house is upwards of ninety miles from here, and as it shook his windows it would probably have been heard another sixty miles further on; this would lead one to believe that the explosions were distinctly audible over an area of at least 150 miles in diameter, and were no doubt produced by a huge exploding fireball. The morning in question was clear and bright. E. G. FENTON.

Rio Gallegos, Patagonia, February 12.

On the Gain of Definition obtained by Moving a Telescope.

Is not the case mentioned by M. E. J. Gheury in NATURE of March 27 (p. 86) but a special case of the familiar fact that an object which is so like its background as to be invisible when at rest is commonly visible when it moves? In this case, as the telescope moved, the signal in its field of view was to the eye fixed to its eyepiece an object moving against the background of misty sky, which it so nearly resembled as to be invisible when at rest. Is not the explanation as follows? Visibility of the object, and in particular of its outline, depends on *contrast* between it and its background. There is commonly *some* contrast, but often so slight as not to attract attention when the object is at rest. When, however, the object moves, the brain receives successive impressions of contrast as the image of the object falls on one part of the retina after another. Thus the brain receives a *cumulative impression of contrast* between the object and the background, and the object becomes "visible."

If this be not, as perhaps it is not, a perfect explanation of this familiar fact, there are probably many others beside myself who will be glad to know what the correct explanation is.

Candahar, Reigate. G. W. BUTLER.

NORTHERN METHODS OF BURIAL IN THE IRON AGE.

MR. SCHETELIG'S excellent memoir[1] describes the recent more precise investigations which correct and elucidate older work. Relics other than from graves are insignificant, and the nominal restriction to Vestland scarcely lessens the interest, for local discoveries are throughout compared with those in other provinces and countries. Neither a *catalogue raisonné* of antiquities, nor a general account of the evolution of Norwegian culture during the Iron Age, the volume serves as a foundation for works of those two different classes. The objective account of the graves themselves, and of the disposition therein of the varied remains, is its endeavour; and its general conclusions relate mainly to the development of burial methods.

FIG. 1.—The Byrkje grave-mound at the beginning of the excavation. From "Vestlandske Graver fra Jernalderen." Bergens Museums Skrifter.

The third and fourth centuries A.D. are, in Vestland as elsewhere, those most influenced by Roman culture, while during the fifth and sixth centuries more original lines were followed. During the third century, however, a greater change occurred than about the year 400; it was

[1] "Bergens Museums Skrifter." Ny Raekke. Bd. ii. No. 1. Vestlandske Graver fra Jernalderen. By Haakon Schetelig. Pp. iii+242. (Bergen: A/S John Griegs Boktrykkeri, 1912.)

also before the latter date that Vestland entered into relations with the West Germanic civilisation on the east coast of the North Sea, and the Anglo-Saxon on its west coast.

Burials without cremation first occurred in the northern countries during the Roman period, and with a broadening of culture the funeral furniture grew more elaborate and diverse. These changes, entering Vestland later than other parts of Scandinavia, affected also the cremation burials, and in the Folk-wandering period (400–800 A.D.) the two kinds tended to fuse. Thus both methods occur in a grave-mound with three graves at Byrkje in Voss (Fig. 1). One of these graves, that of a woman, is further noteworthy as the oldest boat burial in Norway, and approximately contemporary with the sixth-century boat grave in Suffolk. This mode of burial seems to have been the logical outcome of the Charon belief, evidences of which are found about this time in the form of ferry money. Rooting itself naturally and growing exuberantly in the mind of a seafaring folk, this rite bore its richest fruit in the subsequent Viking period, when the gross materialisation of a more primitive symbolism reached its climax. Towards that period there are also observed an increase in the number of weapons, a decrease in the size of the mounds, and a tendency to uniformity of style throughout the whole of the north.

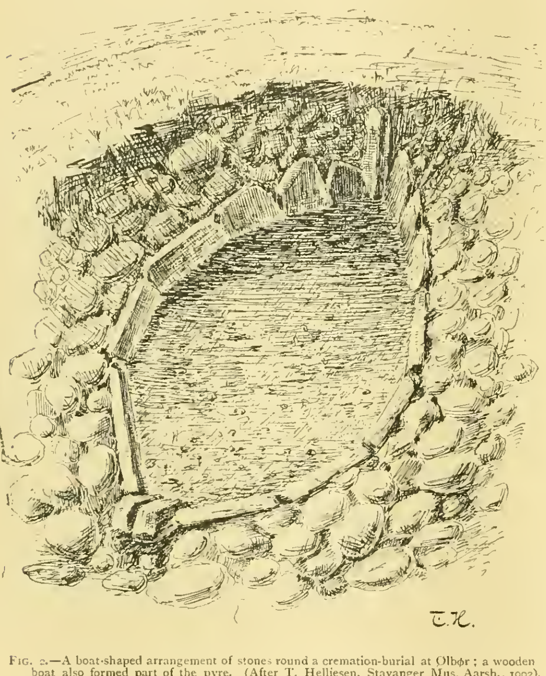


FIG. 2.—A boat-shaped arrangement of stones round a cremation-burial at Ølbør; a wooden boat also formed part of the pyre. (After T. Helliesen, Stavanger Mus. Aarsb., 1902). From "Vestlandske Graver fra Jernalderen." Bergens Museums Skrifter.

Usually in the Viking period there was a funeral pyre on a flat surface, below which the grave was dug and afterwards filled in with large stones, while its position might be marked by one or more gravestones (Fig. 2). The older orientation of head to north was often departed from. This last change and the increased simplicity may betoken Christian customs, if not actually Christian faith. But the halls of the mighty were still homes of heathen worship; their bodies lay when dead with head true to the north of their fathers, and over them, as at Upsala, at Tune, or at Gunnarshaug, were piled the highest mounds with the richest store of goods and the hugest sacrifices known from all Scandinavia.

MIGRATIONS OF BIRDS.[1]

THE volume before us is the seventh of the series of annual reports on migration which we owe to the industry of a committee of the British Ornithologists' Club, which has set itself the task of collecting evidence over a period of ten years, and thereafter of summarising the data thus obtained. The reports have increased progressively both in scope and bulk, and the one before us is a stout volume. It deals mainly with the immigratory movements of birds visiting England and Wales for the purpose of nesting in the summer of 1911. Passage movements are also dealt with, and the autumn movements of 1910 as reported by lighthouses and light-vessels. Summaries of the meteorological conditions are furnished for purposes of comparison.

As the drawing of conclusions is forbidden by the self-denying ordinance of the committee, the volume before us is to be regarded as a summation of facts, and as such it deserves all praise, for everything possible has been done to ensure clearness by condensation, tabulation, and the addition of diagrammatic tables. An immense amount of material has had to be classified and arranged, and we think that the committee has chosen the best course in grouping its facts under the headings of species, although the initial chronological summary is perhaps the most interesting to the casual reader.

The spring migration commenced on March 10 and continued until May 29. During the latter half of April there were three distinct waves of

[1] Report on the Immigrations of Summer Residents in the Spring of 1911; also Notes on the Migratory Movements and Records received from Lighthouses and Light-vessels during the Autumn of 1910. By the Committee appointed by the British Ornithologists' Club. Published as vol. xxx. of the Bulletin of the British Ornithologists' Club. Edited by W. R. Ogilvie-Grant. Pp. 332+20 maps. (London: Witherby and Co., 1912.) Price 6s.

migration—on April 17 and 18, 23, 27 and 28—each of increasing intensity. There was another large influx on May 5. The immigrations of the willow-warbler (probably two races), which lasted from March 11 to May 6, and of the wheatear (two races), from March 19 to May 10, covered the longest periods among the species recorded; while those of the wood-warbler between April 16 and May 13 occupied the shortest time. Notice is drawn to the increasing and now extreme scarcity of the landrail in the south-east of England.

The records which are of most interest merely in themselves are perhaps those to be found in the section dealing with the autumn movements. The autumn of 1910 was noteworthy for the large influx of certain northern species, such as the waxwing, northern bullfinch, mealy redpoll, and continental great tits. Jays were recorded as migrants to the south-east of England, and with them magpies (a flock of twenty), the latter being thus for the first time recorded as migrants to our shores. Great numbers of the little golden-crested wren were on the move round all our coasts between the end of August and mid-November.

LONDON WELLS.[1]

HOW complex and how serious is the problem of maintaining a supply of water suitable to its needs few of the inhabitants of London have any conception. We turn the tap for our morning tub or to fill the kettle for tea and would be surprised and annoyed if the water did not readily flow. During the past few years, however, many large users of water have turned their attention to the provision of private supplies, and the number of wells has greatly increased. The early wells of the city and surrounding area were dug in the superficial gravels and Tertiary formations alone, for in those days they yielded a satisfactory supply without the need of descending further; gradually these shallow wells produced a smaller volume and a deteriorating quality of water, and had to be deepened and sunk into the Chalk.

According to the researches of Mr. A. S. Foord, there were no deep wells either in or near the city till at least the middle of the eighteenth century. It is probable that the difficulty of dealing with the mobile Thanet Sands delayed the introduction of deep wells until the art of overcoming the trouble had been perfected. The yield of many of the older wells was increased by putting a boring at the bottom. Now, the practice of sinking shafts is almost abandoned in favour of boring alone. These borings are lined in the upper portion and are carried as far as necessary into the Chalk. This change has been brought about by the fact that borings are cheaper than dug wells, and that the latter would have to be sunk at least 100 ft. before any water could be reached.

The height of the water level in London wells has been sinking for a long time, but in recent years the fall has been increasingly rapid. This is most clearly brought out in the memoir before us by maps showing the contours of the underground water-surface and by the data supplied with many of the well records. The lowering of the water-level, if continued at the present rate, must seriously affect all wells in the London area, not only as regards quantity, but also quite possibly with respect to quality also. Mr. Barrow has great faith in a remedy for this evil, one which has already proved effective in the hands of Mr. W. B. Bryan in maintaining the level in the waterworks district at Lea Bridge. He recommends that spare water should be conserved in reservoirs in suitable districts and poured as required into dumb wells sunk into the Thanet sand, whence it would permeate into the Chalk; in the introduction to the memoir he brings forward a good deal of evidence in support of this method.

The influence of the Tertiary cover on the quality of the water drawn from the Chalk is remarkable. Water taken from the Chalk beyond the Tertiary outcrop carries a preponderance of lime salts; that from the Chalk beneath the Tertiary is much poorer in lime, which the sodium salts have greatly increased. This change is usually attributed to the influence of the Thanet sand. Dr. Thresh's valuable experiments on the effects of this sand are briefly discussed; but this is a subject of great complexity and requires further study. The work on soils carried out by various agronomic surveys, and that of Cushman and others on the influences of colloids in clays, should have some bearing on the problem.

The well records in this volume are very numerous, and many are published for the first time. They should prove of the utmost value gathered together in this form. Only by complete and accurate records and their careful correlation with geological conditions can an outlook be obtained on the state of the underground water as a whole. If the recording of all borings for water in the United Kingdom were made compulsory, much unnecessary waste would be avoided.

[1] Memoir of the Geological Survey, England and Wales. Records of London Wells, by G. Barrow and L. J. Wills. (H.M. Stationery Office, 1913.) Price 4s. 6d.

THE LISTER MEMORIAL FUND.

WE are informed that the contributions recently made to the Lister Memorial Fund include the following: Clothworkers' Company, 100*l.*; Grocers' Company, 52*l.* 10*s.*; Ironmongers' Company, 25*l.*; Mercers' Company, 105*l.*; Merchant Taylors' Company, 262*l.* 10*s.*; Skinners' Company, 105*l.*; Society of Apothecaries, 52*l.* 10*s.*; Corporation of the City of Glasgow, 52*l.* 10*s.*; Royal College of Physicians, 21*l.*; Royal College of Surgeons, 52*l.* 10*s.*; Royal Dublin Society, 50*l.*; Royal Horticultural Society, 52*l.* 10*s.*; the Royal Society, 50*l.*; Harveian Society, 10*l.* 10*s.*; Pharmaceutical Society, 10*l.* 10*s.*; Physiological Society, 10*l.* 10*s.*; Royal Microscopical Society, 5*l.* 5*s.*; Royal Sanitary Institute, 5*l.* 5*s.*; the

Manchester Cooperative Wholesale Society, 21*l*., and many medical societies. Lord Strathcona has sent a donation of 100*l*., and Prof. Ehrlich, of Frankfurt, has sent one of 500 marks.

Committees for the purpose of collecting subscriptions have been formed by the Universities of Oxford, Cambridge, and Durham, and other universities are also making efforts locally to promote the success of the memorial. Arrangements have also been made for the formation of committees in the British Dominions beyond the seas and in foreign countries.

The proposed memorial will be of a threefold character, and consists of (1) a simple marble medallion bearing a sculptured portrait of Lord Lister, to be placed in Westminster Abbey among the monuments of the nation's illustrious dead; (2) a larger and more conspicuous monument, to be erected in some public place in London, and (3) the founding of an International Memorial Fund, from which either grants in aid of researches bearing on surgery or rewards in recognition of important contributions to surgical science will be made, irrespective of nationality. A considerable sum of money is required to carry out these proposals. Donations should be sent to the treasurers of the fund at the Royal Society, Burlington House, London, W.

NOTES.

Sir Oliver Lodge has been elected president of the British Association, in succession to the late Sir William White, for the meeting to be held in Birmingham next September.

The Lord Mayor has given permission for the annual meeting of the British Science Guild to be held at the Mansion House on Wednesday, May 21, at 4 p.m., when he will preside, and Sir William Mather, P.C. (Lord Haldane's successor to the presidentship), will be present. The annual dinner of the guild will be held on Monday, May 26, at the Trocadero Restaurant. The guild has recently been considering the important question of pure milk and the Government Milk Bill, and has drawn up a report in connection with it. A report has also been prepared on national education, and it will be presented to the Government in connection with the contemplated organisation of our educational system.

Lord Burghclere, chairman of the Royal Commission on Historical Monuments, Sir Thomas R. Fraser, F.R.S., professor of materia medica and clinical medicine, University of Edinburgh, and Mr. E. H. Tennyson-D'Eyncourt, Director of Naval Construction, Admiralty, have been elected members of the Athenæum Club, under the provisions of the rule of the club which empowers the annual election by the committee of a certain number of persons of "distinguished eminence in science, literature, the arts, or for public services."

The death is announced, on April 7, at sixty-nine years of age, of Mr. F. G. Smart, fellow of the Linnean and the Royal Geographical Societies.

Mr. G. C. Curtis is starting for Hawaii in order to carry out a commission to construct for the geological museum at Harvard a relief model of the volcano Kilauea.

Prof. Ira N. Hollis, who has been head of the department of engineering at Harvard since 1893, has resigned his chair in order to accept the presidency of the Polytechnic Institute, Worcester, Mass.

The death is announced, in his seventy-sixth year, of Prof. H. Alexan Bezjian, teacher of physical science in the Central Turkey College, Aintab, Turkey-in-Asia, and described by *The Times* as "one of the most distinguished scientific men that Turkey has yet produced."

The medical faculty of the University of Birmingham has suffered a severe loss by the sudden death of Prof. Jordan Lloyd, who had been a member of the University staff since the foundation of the University, having previously occupied the chair of surgery at Mason College since 1891.

The summer meeting of the Institution of Mechanical Engineers will be held in Cambridge, and will begin on Monday, July 28. On the following day the Vice-Chancellor of the University, the Mayor of Cambridge, and the members of the local committee will receive and welcome the president, Sir H. Frederick Donaldson, K.C.B., and the council and members of the institution, in the Senate House of the University. Papers will be read and discussed on that and succeeding days, and there will be visits to engineering works, laboratories, and places of interest in Cambridge, as well as various social functions.

On Tuesday next, April 15, at three o'clock, Prof. W. Bateson will deliver the first of two lectures at the Royal Institution on the heredity of sex and some cognate problems, in continuation of those delivered before Easter, and on Thursday, April 17, Prof. J. Garstang will begin a course of three lectures on the progress of Hittite studies. The Friday evening discourse on April 18 will be delivered by Dr. T. M. Lowry on applications of polarised light, on April 25 by Prof. J. Garstang on Meroë: four years' excavations of the ancient Ethiopian capital, and on May 2 by Mr. H. G. Plimmer on blood parasites.

A joint meeting of the Institution of Electrical Engineers and the Société Internationale des Electriciens will be held in Paris on May 21–24. The inaugural meeting on Wednesday, May 21, will be held at the Conservatoire des Arts et Métiers. The programme includes papers and discussions on the electrification of railways; long-distance transmission of electrical energy; lighting by means of vapour-tube lamps; and wireless telegraphy. There will be a reception and banquet at the Palais d'Orsay by invitation of the Société Internationale des Electriciens; a kinematograph demonstration by M. Gaumont; visit to the aërodynamical laboratory of M. Eiffel at Auteuil; reception by M. Eiffel at the highest platform of the Eiffel Tower, and inspection of the wireless installation, as well as many other social functions.

The annual meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 1–2. At the opening session the Bessemer gold medal for 1913 will be presented to Mr. A. Greiner, and on May 2 the Andrew Carnegie gold medal (for 1912) will be presented to Dr. J. Newton Friend, and the awards of research scholarships for the current year will be announced. Among the papers that are expected to be submitted are the following:—"Critical Ranges of Pure Iron, with Special Reference to the Point A_2," Dr. H. C. H. Carpenter; "Influence of the Metalloids on the Properties of Cast Iron," H. I. Coe; "Influence of Silicon on the Corrosion of Cast Iron," Dr. J. Newton Friend and C. W. Marshall; "Studies in the Cold Flow of Steel," P. Longmuir; and "Production of Sound Steel by Lateral Compression of the Ingot whilst its Centre is Liquid," B. Talbot.

We have received the prospectus of an International Ornithological, Entomological, and Botanical Exhibition, to illustrate the economic aspects of ornithology, which is to be held from May 3 to June 1 in the Palais des Beaux-Arts at Liége, under the auspices of three Belgian ornithological societies. The exhibition will be essentially "documentaire," that is to say, based on treatises devoted to the economic aspects of ornithology, and its connections with entomology, but it will also include collections of birds, insects, and such plants as furnish, in the shape of their seeds, a large proportion of the food of birds. To render the show more attractive to the general public, collections of butterflies will be admitted. The object of the exhibition is stated to be entirely for the advancement of science, and not for profit. Exhibits are invited, and intending exhibitors requested to send their communications to L. Cuisinier, 155 Rue de Bruxelles, Ans.

The death is announced, on April 6, at sixty-three years of age, of Prof. Adolf C. H. Slaby, inventor with Count Arco of the German system of wireless telegraphy. He had a stroke of paralysis about two years ago, and was obliged to retire from the Charlottenburg Hochschule, of which he was at various periods director. A fortnight ago he had a second stroke, and never recovered consciousness. We are indebted to *The Times* for the following particulars of his career:—Prof. Slaby was from 1884 to 1902 director of the electrical laboratory at the Technische Hochscule, and there began the experiments which led to the perfection of the "Telefunken" system. From the Emperor William, who made his acquaintance when the White Hall of the Royal castle in Berlin was fitted with electric light and gave him frequent encouragement and support, he obtained permission to use the Royal gardens on the banks of the Havel for his experiments. Here he worked the whole of the summer of 1897, sometimes ten hours a day, attempting to establish wireless communication between the Pfauen island in Wannsee and the Pfingstberg. In October of that year he established wireless connection between two captive balloons at a distance of 21 kilometres. The range of the German wireless system, of which Siemens Telefunken Company has acquired the monopoly rights for Great Britain, is now said to be 6000 kilometres.

It is gratifying to learn that the Gypsy Lore Society is now in a flourishing condition, though the number of members is still smaller than it should be. In the second part of vol. vi. of the society's Proceedings Mr. H. L. Williams, of the Indian Police, continues his interesting notes on the criminal and wandering tribes of India. He quotes a current rumour that some of these people in the Punjab and United Provinces of Agra and Oudh are anthropophagous. Two supposed informers are said to have been killed and eaten in a Sánsi camp in the Bhartpur State. The story, as it is recorded, is almost incredible, and seems to be only an instance of the facility with which the settled people in the northern plains are accustomed to accept all kinds of marvellous tales regarding these uncanny and mysterious vagrants.

The Journal of the Royal Anthropological Institute, of which the final part of vol. xlii. has recently been issued, forms a valuable record of the excellent work in physical anthropology, ethnography, prehistoric archæology, and linguistics which the institute, under its present management, is prosecuting. In its *format* and in the abundant illustrations with which it is furnished, it is equal, or perhaps superior, to the publications of any European society which covers the same field of research. It is scarcely creditable to the Empire that work of this kind does not receive more adequate recognition. In any other country possessing opportunities for the study of anthropology a society like this would be supported by a State grant, and would bear on its rolls a much larger number of subscribers. Funds are urgently required for extending its work. In particular, *Man*, the monthly journal of the institute, does not provide adequate space for a record of current literature, and for the publication of short notes or articles of anthropological interest. The institute is most uncomfortably housed, and its library needs extension and better arrangement before it can meet the wants of students. It may be hoped that when the condition of this important branch of research is brought to public notice the institute may meet with adequate support from the State, from students in this country, and from the large body of English officers working among savage races throughout the Empire.

We have before us the first part of a new text-book of physiological histology, by Prof. Sigmund, of Teschen, which is being translated into English by Mr. Lovatt Evans, of University College, London. Carl Zeiss, Ltd., is the London firm responsible for the issue. It is beautifully illustrated, and the descriptive text is admirably lucid and up-to-date. The special feature of the work, however, is that it is accompanied by actual microscopical specimens. Thus part i., which deals with the skin, has with it ten specimens to illustrate the structure of the cutaneous organs. We have nothing but praise for the specimens, and these will be highly prized by those who have not the time or opportunity of making microscopic slides for themselves, but nevertheless desire to examine such specimens. We would, however, caution students that pictures, however beautiful, and bought slides, however perfect they may be, can never really teach them histology. The specimens they prepare themselves may not exhibit the same technique, the rough drawings they themselves execute may not be highly artistic, but the educational value of such far transcends that of purchased specimens or highly coloured diagrams.

We have received from Messrs. Charles Griffin the first number of the sixth volume of *The Quarterly Journal of Experimental Physiology,* which was brought out under the editorship of Prof. Schäfer five years ago. When this new periodical first appeared doubt was expressed in some quarters whether there was room for a new physiological journal. But nothing succeeds like success, and we heartily congratulate its distinguished editor on having justified his expectations in relation to the life and vigour of the journal. The present number contains a noteworthy paper by Prof. Herring on the comparative anatomy and physiology of the pituitary body, a subject which he has made his own; Prof. Schäfer and Mr. Gavin contribute articles on one of the functions of this remarkable gland, namely its influence on the secretion of milk. Dr. Graham Brown continues his studies on the physiology of reflex action. Drs. Cramer and Pringle deal with the much-vexed question of blood-coagulation, pointing out the importance of the platelets in the process, and, finally, Mr. Miller, of Montreal, treats of the nerve centres concerned in the secretion of saliva, and Dr. Grube, of Kansas, on the blocking of nerve impulses. The journal thus deals with many important aspects of physiological progress, and should be on the bookshelves of all working physiologists and others interested in the subject.

Parts i. and ii. of the ninth volume of *Biometrika* are given up mainly to the consideration of statistical methods. Thus 150 pages are occupied by an article of Prof. Karl Pearson's and Dr. David Heron's on theories of association, which would be more interesting and valuable if it were not merely one stage in a controversy between the authors and Mr. Yule. Four papers treat of methods for obtaining the "probable error" of statistical constants of various kinds, and one on the influence of "broad categories" on correlation. Among those contributions which deal rather with practical results than with statistical theory is a study by Mr. A. B. Emmons, of Harvard, on variations in the pelvis of American Indian squaws. His observations are in conformity with the statement of Engelman that labour is as a rule short and easy among North American Indians who marry within their tribe. He finds that in almost three-quarters of the specimens examined the dimensions of the pelvis would have allowed an easy delivery where the head of the fœtus was about the normal size. Another paper dealing with a subject of considerable importance is that of Mr. E. C. Snow on the intensity of natural selection in man. This is a supplement to his original memoir, which has already been noticed in Nature.

The January issue of *Science Progress* (No. 27, 1913) contains an article by Dr. R. R. Armstrong on the mechanism of infection in tuberculosis. Dr. Armstrong expresses the opinion that infection of children from tuberculous milk is of minor importance, and that in their case, as with adults, infection is mainly with the human type of tubercle bacillus by way of the respiratory tract.

A pamphlet on the house-fly as a danger to health: its life-history and how to deal with it, by Mr. Ernest Austen, has been issued by the trustees of the British Museum at the price of 1*d.* It gives in simple language the life-history of the house-fly and describes its breeding habits and its dangers to health. The pamphlet is illustrated with two full-page half-tone plates of the house-fly and lesser house-fly and of the house-fly maggots.

We have received a small volume entitled "Anleitung zur Kultur der Mikroorganismen," by Dr. Ernst Küster (B. G. Teubner, second edition, 1913). It contains a very complete account of the methods and media employed for the cultivation of the protozoa, bacteria, myxomycetes, algæ, and fungi. The matter has been brought well up to date, including, for instance, the work of Bass on the cultivation of the malaria parasite. The price is 8 marks.

To the March number of *The Zoologist* Prof. Stanley Gardiner contributes a highly appreciative and sympathetic memoir of the late Prof. Adam Sedgwick, with special reference to his early work and associates at Cambridge, and the gradual building up of the modern school of morphology at that University.

In the *Boletin de la Sociedad Physis,* vol. i., No. 3, Mr. A. Gallardo gives an account of a plague of ants which made their appearance in certain parts of the province of Buenos Aires during 1904–5. The species is the so-called Argentine or New Orleans ant, *Irodomyrmex humilis,* an exceedingly prolific insect, of which colonies have made their appearance during the present century in New Orleans, Madeira, Portugal, and elsewhere. In the opinion of the author this aggressively colonising ant is probably an immigrant into Buenos Aires, and its real home some part of tropical America.

To the Smithsonian Institution we are indebted for a notice of a complete skeleton of an armoured dinosaur, *Stegosaurus stenops,* which, although discovered near Canyon City, Colorado, so long ago as 1885, has only just been placed on public exhibition in the U.S. National Museum. Alongside is placed a restoration of the reptile as it probably appeared in life. When discovered, the skeleton was lying on its back, in such a manner as to suggest that the reptile had met its death by violence, and the remains have been mounted in the same position, the conformation of the back being displayed by means of mirrors arranged beneath.

In reference to the recommendation in the "First, Second, and Third Reports from the Committee of Public Accounts" that a periodical stocktaking should be instituted in national museums and galleries, and also that the results of such surveys should be subject to review by the Controller and Auditor-General, it is pointed out in the March number of *The Museums Journal* that in the British Museum alone a small army of officials would be required for a task of this nature. It is added that if the registers in any museum or gallery are not properly kept up to date, the fault is due to the inadequacy of the staff.

The report of the Department of Agriculture of the Union of South Africa has been issued in the form of a Blue-book. Although work has been disorganised by changes in administration, the report contains many interesting accounts of the investigations carried out by the various branches of the service. Amongst these may be mentioned the inquiry as to the cause of lamziekte (lame-sickness) undertaken by Dr. Theiler and Mr. Burtt-Davy, a discussion of which appears in the report of the agrostologist and botanist. Observations already made would appear to indicate that the complaint is not transmissible, and is more or less analogous with the "pica" disease of North Germany and the cornstalk disease of the United States. The view is expressed that the disease is due to the action of a plant poison, which is generated in grasses or other plants normally innocuous. Its development is associated with certain climatic and telluric conditions in which summer drought is an important factor. In this way the conditions responsible for the wilting of grass also favour the formation of the toxin, and this tends to explain the view commonly held that the disease is caused by the consumption of such wilted grass.

To the February issue of the Journal of the Meteorological Society of Japan Mr. J. Otsuki contributes a detailed report, accompanied by a map, of an eruption of Asama-yama on December 14, 1912. The author notes that this volcano has been particularly active in recent years. A violent outburst occurred 130 years ago, but from that time to 1909 the eruptions, though frequent, were of a minor nature. In May of the latter year an alarming eruption occurred, since when the volcano's activity has increased, no fewer than five serious outbursts being recorded in the past four years. The latest manifestation caused considerable consternation over a wide area. The reverberations of the explosion, which are likened to the booming of artillery, had earthquake-like effects on the near-lying villages, and were heard over an area of nearly 16,000 square miles, while a rain of white ash fell during the day of the eruption and the following day, covering ground extending for 2500 square miles. The column of dust and vapour rising above the volcano during the eruption was estimated to have been nearly two miles high.

Some interesting details, accompanied by synoptic charts, relating to the disastrous hurricanes of November last in Jamaica are given in the United States meteorological chart of the North Atlantic Ocean for March, and in a report (No. 411) by Mr. Maxwell Hall, Government meteorologist for the island. Mr. Hall refers to three distinct disturbances: A, an ordinary depression until it curved round the west end of the island; B, a fully developed cyclonic hurricane which struck the south-west coast, travelling in a north-easterly direction; C, a small inland depression which broke the telegraph wires, November 16 and 17. On the morning of November 14 one of several useful warnings issued by the Washington Weather Bureau located a storm 400 miles south-west of Kingston; this storm Mr. Hall refers to by the letter B. At noon on November 17 the storm A was off Negril lighthouse, moving very slowly, and at midnight was overtaken by B. The subsequent action between these storms was very remarkable; Mr. Hall says:—"Every barometric pressure, as well as every direction of the wind, was affected by two or three cyclones, and with the data at hand it is not possible to separate the effects." After A passed out to sea north-east of Montego Bay, it returned rapidly southward, and placed itself between Kempshot on one side and cyclone B on the other. The registered wind velocity reached 120 miles an hour at Negril on the morning of November 18, and at Kempshot (Montego Bay) the same evening a similar rate was estimated. Several towns were entirely destroyed; at Savanna-la-Mar the sea wave was the highest within a century, and the sea was driven half a mile up the principal street.

Almost the whole of the March number of *Terrestrial Magnetism and Atmospheric Electricity* is devoted to a description of the theory, construction, and working of the earth inductor made by the Carnegie Institution of Washington for the determination of dip on board the magnetic exploring ship *Carnegie.* The coil of the inductor rotates about a diameter which can be set at any inclination and in any azimuth. Rotation of the coil will in general produce an alternating current, which only becomes zero if the axis of rotation coincides with the direction of the magnetic field at the place of observation. A telephone in series with the coil would determine the position of the axis for zero current, if the axis could be kept fixed in the proper direction. Since at sea this is not possible, the coil is provided with a two-part commutator, which rectifies the current and sends it through a moving-coil galvanometer. By reading the deflections of the galvanometer when the axis has several positions near the correct one, and the coil is rotated at a constant speed, the dip is determined on the *Carnegie* with an accuracy of about three minutes of arc.

The volume of "Records of the Survey of India, 1910–11," contains discussions on the pendulum and latitude observations made in Sind and Baluchistan, where the arrangement of the mountain masses seems to show marked differences from that found in the vicinity of the main Himalayan region. In the first place, the average deflection of the plumb line is found to be remarkably small, and in general the attraction of the visible mountain masses is much less than could have been anticipated. The geological structure of the whole area is, however, very complicated, and it would appear that far more information, both as to the surface forms and as to the gravity variations, is required before any very definite conclusions can be drawn. Possibly, as suggested by Colonel Burrard, the Eötvös torsion balance might give information which would usefully supplement that derived from other sources. It is to be hoped that the Indian Survey will give a trial to this most interesting instrument. A curious fact elicited is that there seems to be a slow alteration in the vibration periods of a number of pendulums at the same place, Dehra Dun. Thus all four pendulums used showed the apparent force of gravity as highest in January, 1904, and lowest in November, 1909, with a distinct rise since. No cause can be suggested to account for this variation. An investigation as to how far the Indian observations conform to the requirements of "isostacy" promises interesting results, but is as yet only in a preliminary stage.

The *Alsatian*, which is the first of two quadruple-screw turbine steamers being constructed for the Allan Line, was launched from the yard of Messrs. Wm. Beardmore and Co. on March 22. An illustrated account of this vessel, which is 600 ft. long and of gross tonnage about 18,000, appears in *Engineering* for April 4. A notable feature is the adoption of the cruiser stern, an arrangement which permits of a greater displacement on a given length over-all, with corresponding increase in dead-weight, or, if the displacement be not increased, the lines may be fined down, so that the ship is more easily driven, with corresponding reduction in engine power. Further, the fuller water lines aft which are permissible with this type of stern ensure greater stability, especially at the deeper draughts. It is probable also that this form of stern tends to reduce the vibration due to the propellers. Hitherto the Board of Trade has only required a vessel to be capable of remaining afloat with any two adjacent compartments open to the sea. In the *Alsatian*, the aim of the designers has been to ensure her remaining afloat with four adjacent compartments open to the sea.

We have received from Messrs. George Philip and Sons, Ltd., of Fleet Street, London, a specimen of a very handy, light terrestrial globe, 6 in. in diameter, showing by bold blue lines the new routes which will be opened when the Panama Canal is completed. "The Panama Canal Route Globe," as it is named, costs only 2*s*. 6*d*. net, and explains easily what a convenience to ocean travel the new canal will be.

Messrs. Charles Griffin and Co., Ltd., announce the following new books and new editions. In *Chemistry*:—The Petroleum Technologist's Pocket Book, by Sir Boverton Redwood, Bart., and A. Eastlake; Roberts-Austen: Addresses and Scientific Papers, together with a Record of the Work of Sir William Chandler Roberts-Austen, K.C.B., F.R.S., compiled and edited by S. W. Smith, illustrated; A Manual on the Examination of Fuel, by J. H. Coste and E. R. Andrews, illustrated; Outlines of Stationery Testing, by H. A. Bromley, illustrated; A Treatise on Petroleum, by Sir Boverton Redwood, Bart., new edition in three volumes, illustrated; A Handbook of Petroleum, by Capt. J. H. Thomson and Sir Boverton Redwood, Bart., new edition, revised throughout and added to by Major A. Cooper-Key and Sir Boverton Redwood, Bart., illustrated; The Synthetic Dyestuffs, and the Intermediate Products from which they are derived, by Dr. J. C. Cain and Dr. J. F. Thorpe, F.R.S., new edition. In *Engineering*:—Coast Erosion and Protection, by E. R. Matthews; The Dock and Harbour Engineer's Reference Book, by B. Cunningham; Electricity in Mining, by Siemens Brothers Dynamo Works, Ltd., illustrated; Griffin's New Guide to the Board of Trade Examination for Marine Engineers, by R. A. McMillan, part ii., Elementaries, Verbals and Drawing; A Manual of Petrol Motors and Motor-cars, comprising the Designing, Construction, and Working of Petrol Motors, by F. Strickland, new edition. In *Geology*:—A Text-book of Geology, by Prof. J. Park, illustrated. In *Mathematics and Physics*:—Electricity and Magnetism, by Prof. J. H. Poynting, F.R.S., and Sir J. J. Thomson, F.R.S., 2 vols., vol i., illustrated. In *Metallurgy*:—Autogenous Welding: a Practical Handbook on the Installation, Working, and Manipulation of Oxy-Acetylene Welding Plant, for the Unition of Metals without Flux or Compression, from the French of R. Granton and P. Rosemberg, translated by D. Richardson, illustrated; Practical Assaying, by Prof. James Park, revised and enlarged from the third New Zealand edition; Rand Metallurgical Practice, vol. i., new edition. In *Technology*:—Engraving for Calico Printing, by W. Blackwood, illustrated; Painters' Colours, Oils, and Varnishes, Hurst's Practical Manual, new edition, revised throughout and re-written by N. Heaton, with a chapter on Varnishes by Dr. M. B. Blackley, illustrated; Painting and Decorating, by W. J. Pearce, new edition, illustrated.

OUR ASTRONOMICAL COLUMN.

Nova Geminorum No. 2.—In No. 4638 of the *Astronomische Nachrichten* three series of magnitude determinations of Nova Geminorum No. 2 are published. The first, from the University Observatory, Tokyo, commences with the nova's magnitude 5·1, on March 23, and observations were continued until August 17, when its magnitude was 7·89. Both the other sets of observations come from the Observatory of Cracow. The longer list gives the magnitude 3·96 for the nova on March 14; by the time the last determination was made, May 19, its light had dimmed to magnitude 7·60.

Light-changes of α Orionis.—A list of 293 magnitude determinations of α Orionis, made between November, 1901, and August, 1912, by Mr. C. P. Olivier, of the Leander McCormick Observatory, is given in No. 4637 of the *Astronomische Nachrichten*. The table gives, in four columns, the date, Greenwich mean time, determined magnitude, and number of comparison stars used. The values found range from 0·21 (twice) to 1·06 (four times). Under the usual treatment the observations failed to reveal any regularity in the light changes.

Photographs of Comet Brooks (1911*c*).—Dr. Luigi Taffara (*Mem. della Soc. d. Spett. Ital.*, disp. 1a, vol. ii., ser. 2a, p. 11) publishes an account of his photographic work on this comet during September, 1911. His observations were made at the Collurania Observatory in Teramo, at the invitation of Dr. Cerulli. The instrument employed was a Cooke triplet of 16·5 cm. aperture and 1·09 metres focal length. This camera was mounted on the equatorial constructed by Salmoiraghi (aperture 13·5 cm. and focal length 1·75 metres), which was used as a finder. In addition to giving a table of positions of the comet for several dates, he publishes a series of photographs of its form, displaying the remarkable changes which the tail underwent.

Franklin Adams Chart of the Sky.—The Royal Astronomical Society has undertaken the publication of a limited number of reproductions of the Franklin-Adams chart. The 206 sheets form a complete map of the whole sky, the area of each being 15° by 15°. It will be remembered that the original plates were secured with a 10-in. Cooke triplet objective of 45 in. focal length; the negatives show stars down to the sixteenth and seventeenth magnitudes. The reproductions will be on bromide paper, 15 by 12 in., the chart area being 11 by 11 in. The complete price will be ten guineas, and it is expected that the first sets will be ready for delivery in twelve months' time. It is hoped that a sufficient number of subscribers will be enlisted to help to defray the cost of such an expensive undertaking.

A Cheap Form of Grating Spectrograph.—In the current number of *Knowledge* (vol. xxxvi., No. 537, p. 142) Mr. A. H. Stuart describes what seems to be a new form of spectroscope in which a transmission grating is used. The instrument is there illustrated by two diagrams, and the principle involved can be easily grasped. The instrument is of the rectangular box form, having the slit and camera at one end of the box. The light, after passing through the slit, falls on an objective, at the back of and nearly in contact with it being placed a replica grating; behind this grating is placed a plane mirror at a distance of a few inches. The beam of light passes through the slit to the objective, and falls normally on the grating. A large portion of the light passes through the grating unchanged, and falls on the mirror. If it meets the mirror normally it will be reflected back to the grating, and a spectrum will pass out obliquely through the object glass and fall on the photographic plate at the camera end to one side of the collimator. In order to avoid the faint reflection spectrum the grating is retained in its position at right angles to the incident beam, but the mirror is slightly twisted. Thus a pure spectrum of considerable dispersion is obtained. Mr. Stuart has constructed such an apparatus by the judicious use of 20*s*., the achromatic lens, 2 in. in diameter, costing 3*s*. 6*d*., and the grating 10*s*. 6*d*.

Khedivial Observatory, Helwan.—Two bulletins, Nos. 8 and 9, from this observatory indicate the useful astronomical work that is being accomplished in Egypt. The first gives an account of the method adopted and the results obtained in determining the astronomical positions of El Daba'a, Mersa Malrûh, Baqbaq, Sollûm, and Siwa. The work was carried out by Messrs. E. B. H. Wade and H. Knox Shaw.

The second of the two bulletins contains the results of the first three years (1909–11) of nebular photography with the Reynolds reflector obtained by Mr. H. Knox Shaw. It is stated that during this period the instrument was constantly undergoing alterations and repairs, so that some of the plates are not so good as they might be. Nevertheless, some of them afford considerable information as to the structure of some nebulæ not hitherto photographed. The table gives the new general catalogue numbers, the positions for 1900 and remarks, and four plates, each containing four or more reproductions, conclude the publication. Attention is directed to the advantage of making drawings of the smaller and less brilliant nebulæ from the negatives, a method which is capable of reproducing the general form of the nebula almost as accurately as any photographic reproduction.

THE DEVELOPMENT OF THE PARASITE OF INDIAN KALA-AZAR.

In a recent memoir with the above title,[1] Captain W. S. Patton gives a detailed account of investigations carried on by him in Madras upon the development and transmission of the parasite of Kala-azar, commonly known as *Leishmania donovani*. As the result of numerous experiments with various blood-sucking insects, the author concludes that the transmission of Indian Kala-azar from man to man is effected solely by bed-bugs of the genus Cimex, and finds that the parasite develops as readily in *C. lectularius*, the species common in Europe, as in the Indian species, *C. rotundatus*. The development observed by the author takes place entirely in the digestive tract of the bug, and is in the main as follows.

The bug takes up the parasite from an infected person in the leishmanial form, that is to say, as the familiar "Leishman-Donovan body," contained either within white blood-corpuscles or in macrophages, in the peripheral blood. After being ingested by the bug, the parasites remain in an unchanged condition for some thirty-six to forty-eight hours. The earliest developmental changes in the gut of the bug may take place while the parasite is still enclosed in a leucocyte or after it has been set free by disintegration of the host-cell, and consist of an increase in the size of the parasite, with enlargement of its trophic and kinetic nuclei. As growth proceeds, the parasites may multiply by binary fission.

The next event in the development of the parasite is the formation of a flagellum, which takes place from the third to the fifth day after the last feed of infected blood. A young, growing parasite may, without dividing, become elongated and spindle-shaped, and acquire a flagellum; or it may first multiply by binary fission, after which each of the two daughter individuals acquires a flagellum; or the parasite may go through a process of multiple fission, in which the two nuclei, trophic and kinetic, divide each into eight or more, and as many flagella grow out, with subsequent division of the body into a number of flagellated daughter-individuals. However the details of the process may vary, the final result is the same, and by the fifth day the parasites, considerably increased in number, have the form of long, actively moving flagellates of the Herpetomonas type, familiar to all those who have studied the development of the parasite in artificial cultures ever since these changes were first discovered and described by Rogers.

About the sixth or seventh day the flagellate parasites are observed to be attaching themselves by their flagella to the intestinal wall of the bug. When thus attached, the body of the parasite slowly rounds up and at the same time it divides; the smaller forms thus produced divide again, and meanwhile the flagellum becomes shorter, and finally disappears altogether. The result of these changes is that the parasite reverts again from the herpetomonad phase to the form of the small, non-flagellate leishmanial body, distinguished by the author as the "post-flagellate" phase, though it does not appear to differ in any essential detail from the initial "preflagellate" leishmanial form, but is described as having a distinct envelope ("periplast"). The post-flagellate stage in the bug begins about the eighth day, and is completed by the twelfth.

According to Captain Patton, this post-flagellate stage represents the final stage of the development of the parasite in the bug. He

[1] Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India. No. 53, "The Development of the Parasite of Indian Kala-Azar." Pp. v+38+1 plate. (Calcutta: Government Printing Office, 1912.) Price 1*s*. 2*d*.

believes that the post-flagellate phase finds its way back again to the human being, when the bug feeds again, by regurgitation from the intestine. Proof of this is as yet lacking, but he hopes in future experiments to solve this part of the problem once and for all. He states that if the bug takes a fresh feed of blood when the parasites in its intestine are in the flagellated phase, they are all destroyed, and cannot develop further. "Human blood has some body in it which not only prevents the process of flagellation, but also destroys the flagellates. This substance is in all probability the complement, and it is known that it is itself destroyed in about two days, when blood is drawn from the human body. This fact further explains why the parasite only begins its development in the bug on the second day. . . . Though many bugs may become infected, only those which do not feed again till the parasite has passed back to its post-flagellate stage are infective." He believes that only in its "post-flagellate" leishmanial form can the parasite resist the destructive action of fresh blood and re-infect the vertebrate host.

The author's conclusion that a non-flagellate leishmanial stage is the final phase in the development of the parasite in the insect-host is based largely on a comparison with the herpetomonad parasites of insects; that is to say, on an analogy with species which are parasitic in invertebrate hosts alone and have no alternate vertebrate host in their life-cycle. In such species, however, the infection of new hosts is effected (apart from the possible occurrence of "hereditary" infection) by the contaminative method; that is to say, by means of resting, non-flagellate phases, usually encysted, which pass out of the host in the fæces, and are accidentally swallowed by another insect-host. On the other hand, in all known cases where a flagellate parasite has an alternation of hosts, vertebrate and invertebrate, and where the vertebrate host is infected by the inoculative method, that is to say, by the parasite being injected into it through the mouthparts of the invertebrate in the act of sucking blood; in all such cases that have been investigated accurately up to the present, the final stage of the parasite in the invertebrate host is an active flagellate. Further, it has been frequently observed in, for instance, the development of trypanosomes in their alternate invertebrate hosts that the active, flagellate forms, usually crithidial or herpetomonad in type, may pass temporarily into a resting, non-flagellate, leishmanial phase during hunger-periods, when the ingested blood is digested and absorbed, and become active flagellate forms again when the host takes in a fresh supply of food.

From these considerations the possibility is not to be excluded at present that Captain Patton's observations may be capable of an interpretation different from that which he places upon them. It may well be that his "post-flagellate" stage represents a resting phase upon which the parasite enters when the blood taken up by the bug is digested, and that when the bug feeds again these resting forms will become active once more, and give rise to a final flagellate stage, yet to be discovered, which will be inoculated ultimately into the human being. It must, however, be borne in mind that it has not yet been proved definitely that the parasite passes from the bug into the human being by inoculation through the proboscis; if, as is at least possible, the parasite is destined to pass out of the bug in its fæces, it is then probable in the highest degree that the final stage in the development in the bug would be a resting, non-flagellate phase.

The final decision, however, with regard to the transmission of the parasite of Kala-azar will rest, not upon analogies with other parasites, but upon facts demonstrated with regard to this parasite itself, and if Captain Patton establishes his statements, he will have added a new type of development and transmission to those known already to occur in flagellate parasites of vertebrates transmitted by blood-sucking invertebrates. However this may be, the author is to be congratulated on having brought forward very strong evidence to show that, as suggested originally by Rogers, the spread of this very deadly human disease is to be attributed to the agency of the bedbug, a discovery of immense practical importance.

E. A. Minchin.

NEW ZEALAND VEGETATION.[1]

In a brief general account, contributed to the "New Zealand Year-book, 1912," Dr. L. Cockayne, F.R.S., who has done so much floristic and ecological work in New Zealand, points out that owing to its long isolation and diverse elements (Malayan, Australian, subantarctic, and endemic), the flora of New Zealand is of special interest.

The vascular plants in this flora—ferns, fern-allies, and seed-plants—number, so far as at present known, about 1700 species, of which about three-fourths are endemic. Of the lower plants—algæ, fungi, lichens, liverworts, and mosses—many hundreds have been described, including many remarkable genera and species, but there can be no doubt that hundreds more remain to be described. The ferns and fern-allies form a striking feature in the vegetation in some areas, but are not of such great relative importance in the New Zealand flora as has sometimes been supposed; still, about 160 species of these plants are known.

Among the seed-plants, the daisy family is the largest, as might be expected, having more than 230 species; the sedge, grass, and figwort families follow with more than 100 species each, while between thirty and seventy species belong in each case to the orchid, carrot, buttercup, bedstraw, epacrid, willowherb, pea, rush, and forget-me-not families.

Among genera which contain many species and are marked by great variability, making them difficult to define and classify, Dr. Cockayne mentions Veronica, Carex, Ranunculus, Senecio, Epilobium, and Myosotis. The genus Veronica, with more than 100 species, is remarkable for its variability and for the almost endless variety of habit assumed by the various species, some of the New Zealand speedwells (mostly endemic and largely alpine in habitat) being small trees, while the majority are shrubby and often dwarf, frequently simulating cypresses and other conifers owing to their reduced and appressed leaves. Apart from variability in the adult plants, about 100 New Zealand species, belonging to different genera, have juvenile forms which are quite distinct from the adult forms, and may retain their juvenile characters for many years; this is seen in various trees, such as lace-bark, lancewood, and ribbonwood.

Among the multitudinous growth-forms, characteristic of diverse life conditions, the more remarkable are the climbers with woody rope-like stems, resembling the lianas of the South American tropical forests; shrubs with wiry interlaced branches forming close masses; the curious cushion-plants, sometimes of immense size, as in the vegetable sheep (species of Haastia, Raoulia, and Psychrophyton); leafless shrubs with round or flattened stems, and so on. The woody plants are almost all evergreen, only some twenty species being deciduous or semi-deciduous; herbs that

[1] "The Flora of New Zealand." By Dr. L. Cockayne. Extract from the "New Zealand Year-book, 1912."

die to the ground in winter are rare, as are bulbous plants.

The plant associations of New Zealand, on which Dr. Cockayne has written so extensively,[2] are of surpassing interest; to find an equal variety a continent extending to the tropics would have to be visited. The northern rivers and estuaries display a mangrove vegetation—a unique and unexpected occurrence outside of the tropics. The lowland and montane forests are of the tropical rain-forest type, and are distinguished by the abundance of filmy ferns, tree-ferns, woody climbers, massive perching plants, deep carpets of mosses and liverworts, and trees with buttress-roots. The high-mountain forests are subantarctic in character, and are usually dominated by the southern beech (Nothofagus). Wide areas are covered by shrub heath, fern heath of tall bracken, and moorland with bogs, while grass-land with tussock grasses is a great feature of the volcanic plateau of the North Island and of the east of the South Island; species of Poa and Festuca form the chief tussocks of the lowlands and lower hills, but at higher altitudes species of Danthonia are dominant.

The alpine vegetation contains, excluding lowland plants which ascend to the mountains, about 550 species, most of which never descend below 1500 ft. altitude, while some are confined to the highest elevations. The most beautiful of New Zealand flowers, with but few exceptions, belong to this mountain flora—the great white and yellow buttercups, the marguerite-flowered celmisias, and the variously coloured ourisias, eyebrights, forget-me-nots, and many more. The growth-forms are often striking—cushion-plants, rosette-forming plants, stiff-branched shrubs, mat-forming plants, and other xerophytes are much in evidence, showing the usual xerophilous leaf-characters (hairiness, leathery structure, rigidity, needle-points, &c.).

The floras of the Kermadecs, Chatham Islands, and the Subantarctic Islands (Snares, Auckland, Campbell, Antipodes, Macquarie)—island groups far distant from the mainland—are distinctly part of that of New Zealand. The Kermadecs contain 114 species of vascular plants, only twelve of which are endemic, while seventy-one belong to New Zealand proper; the largest island (Sunday Island) is covered with forest in which *Metrosideros villosa*, a near relative of the pohutakawa (*M. tomentosa*), is the dominant tree. The Chatham Islands have 235 species, twenty-nine of which are endemic, while the remainder of the flora is found on the mainland. The chief plant associations are forest, moor, and heath; on the moors are great thickets of the purple-flowered shrub *Olearia semidentata*, while there are two remarkable endemic genera, Coxiella (an Umbellifer) and Myosotidium (a giant forget-me-not)—both now almost extinct, unfortunately. The Subantarctic Islands have a dense vegetation consisting of 194 species, of which no fewer than fifty-two are endemic, the rest occurring in New Zealand, but chiefly in the mountains. Forest is found only on the Snares and the Aucklands, the dominant trees being an Olearia and a Metrosideros respectively. Very dense scrubs occur on the Auckland and Campbell Islands, and moors are characteristic of all the islands, owing to the enormous peat-deposit and the frequent rain. The Cook Islands, though forming a part of the dominion, have a Polynesian flora quite distinct from that of New Zealand, and are therefore not included in Dr. Cockayne's notice, while, on the contrary, the flora of the Macquarie Islands, though belonging to Tasmania, is a portion of that of New Zealand.

[2] See, for instance, the papers reviewed in Nature, vol. lxxxviii., pp. 51, 590.

The indigenous flora has been invaded by an important introduced element, consisting of about 540 species, mostly European, which has followed in the wake of settlement. Dr. Cockayne points out that although these aliens are in active competition with the true native plants, the widespread opinion that the latter are being eradicated in the struggle is quite erroneous. Where the vegetation has never been disturbed by man, there are no foreign plants at all, but where man has, by farming operations, stock-raising, and burning, brought about European conditions, the indigenous plants have given way before artificial meadows with their economic plants and accompanying weeds. On the tussock-grass areas, however, invaders and natives have met, and though the original vegetation has changed, there is no reason to consider the one or the other as the victor. On the contrary, it appears likely that both will persist, and in course of time a new flora and vegetation will be evolved.

F. C.

PALÆOZOIC AND OTHER ECHINOIDS.[1]

The Echinoidea afford probably greater opportunities for accurate phylogenetic study than any other class of animals. This is due to the fact that a fossil Echinoid is, when well preserved, often as complete for morphological, and even ontogenetic, examination as a recent specimen. No work on recent Echinoids could be adequately carried out without reference to the fossil forms, while any classification of the group based on structures other than skeletal would exclude more than half the available material.

There could be no better proof of the absolute interdependence of zoology and palæontology than the volume before us. The work aims primarily at a revision of the known Palæozoic Echinoids, but before the characters and relations of those highly specialised forms can be well understood, an exhaustive general survey of the morphology of the whole class is necessary. Conversely, it is surprising, but none the less gratifying, to find that the fullest account of the lantern of a recent Echinoid yet published is included in a work mainly concerned with Palæozoic types.

In the introduction a valuable summary of the methods of research (based largely on those of Hyatt) is given, together with useful technical hints for the preservation and development of recent and fossil Echinoids.

The first section of the work is devoted to a detailed account of the comparative morphology of the class. Beside the study of the lantern already mentioned, three features stand out preeminently in this part. Teratological and other irregularities of development are here systematised for the first time, and their value in the interpretation of normal conditions is clearly established. The apical system, considered biometrically, is found to yield important evidence of the direction of evolution in species, especially among the regular Echinoids. But perhaps the most noteworthy conclusion reached concerns the actual composition of the test. It is shown that the only parts of the Echinoid skeleton that occupy an interradial position are the genital plates and the braces of the lantern. Each interambulacrum is really composed of two separate halves, each half having its origin in the same ocular plate as the contiguous ambulacrum.

The systematic classification contained in the second section of the work is concerned chiefly with the regular Echinoids. The only striking novelty is found

[1] Memoirs of the Boston Society of Natural History. Vol. vii., "Phylogeny of the Echini," with a Revision of Palæozoic Species. By Robert T. Jackson. Pp. 491+76 plates. (Boston: Printed for the Society, 1912.)

in the subdivision of the Centrechinoida (*olim* Diademoida). Here the characters of the jaws are used as the guiding features in the separation of three suborders.

The final part of the paper gives a complete survey of all Palæozoic Echinoids hitherto described, and, naturally, includes the description of several new genera and species. The completeness of the revision may be gauged from the fact that figures are given of all but four of the known species. The seventy-six plates accompanying the paper are partly photographic and partly diagrammatic, both alike admirably clear. A full bibliography and an adequate index bring to a fitting conclusion a work that must always remain a classic to echinologists, and a model to workers on other groups.

H. L. H.

CHEMISTRY OF THE SUGARS.

PROF. EMIL FISCHER'S latest paper in the final part of the Berlin *Berichte* for 1912 brings another chapter in the chemistry of the sugars to a close. His welcome return to the subject has been attended with the same brilliant experimental dexterity which led to his former successes in this remarkable group of compounds, and it is to be hoped that he will yet succeed in conquering the still unsolved problem of the synthesis of the disaccharides. Fischer now describes the conversion of ordinary glucose into a methyl pentose, and is enabled to clear up the constitutional formulæ of the stereoisomeric methyl pentoses and effect their complete synthesis from the elements.

The methyl pentoses are a somewhat remarkable group of compounds; they represent sugars of the type of glucose in which one hydroxyl group is reduced so that $CH_2.OH$ is replaced by CH_3. At first their occurrence was rare and limited to a few coloured glucosides. Many more of these have been described recently, but the group is most widely represented amongst the seaweeds, the investigation of which we owe to Votoček. As a result of his work, several isomerides of rhamnose, the methyl pentose which was first discovered, are known.

Fischer started from a dibromo-derivative of glucose, discovered by Fischer and Armstrong ten years previously. The one bromine atom in this substance is attached to the carbon atom at one end of the chain of carbons which constitutes the skeleton of glucose; it is easily replaced by methoxyl and a glucosidic compound formed. The position of the second bromine was uncertain; there were reasons for considering it as attached to the other end of the chain. This position is now confirmed by the fact that when the bromine atom is reduced the glucoside of a methyl pentose is formed from which the methyl pentose is in turn obtained. The new sugar proves to be identical with a compound described by Votoček, and receives the name isorhamnose. Its configuration formula must be the same as that of glucose, and it is easy to deduce the formula of rhamnose and other members of the group.

A side issue of the research, which, however, possesses the very greatest interest, is the behaviour of the new glucoside of isorhamnose towards enzymes. Like the β-methyl glucoside, from which it is derived, it is hydrolysed by emulsin, though somewhat more slowly. Apparently the substitution of CH_3 for $CH_2.OH$ is not sufficient to put the compound out of harmony with the enzyme; this is what might be expected in view of Irvine's proof that tetramethyl-β-methyl glucoside is likewise hydrolysed by emulsin. It is therefore all the more remarkable that β-methyl xyloside, which differs only in that the CH_3 group is replaced by H, is not acted on by the enzyme in the very least.

A more striking proof of the selective nature of enzyme action could not well be desired, and the moment is opportune to emphasise this fact, since it is fundamental to the interpretation of vital phenomena.

E. F. A.

GYROSTATS AND GYROSTATIC ACTION.[1]

WE are accustomed in daily life to handle non-rotating bodies, and their dynamical properties excite little attention, though it cannot be said that they are commonly understood. It is different, however, with rotating bodies. These, when handled, seem to be endowed with paradoxical, almost magical properties. I have here an egg-shaped piece of wood. I place it on the table and it rests, as we expect it to do, with its long axis horizontal. Our experience tells us that this is the natural and correct position of the body. But I set it spinning rapidly on the table, as you see, with the long axis horizontal, and you observe that after an apparently wobbling motion it erects itself so that its long axis is vertical. It was started spinning about a shortest axis, but the body has of itself changed the spin, and it is now turning about the long axis. In taking this position it has actually raised itself against gravity, through a height equal to half the difference between the lengths of the long and short axes. This seems paradoxical, but the man who is in the habit of spinning tops knows that this is the proper position of the body, that it must stand up in this way when spinning rapidly on a rough horizontal plane.

This experiment may be performed at the breakfast table with an egg as the spinning body. But the egg must be solid within—that is, it must be hard-boiled; a raw or soft-boiled egg will not spin. Perhaps this was why Columbus did not adopt this method for his celebrated experiment; there may, of course, have been other reasons.

It is thus made clear that by causing a body to rotate rapidly we endow it with new and strange properties. Between a top when spinning and the same top when not spinning there is a difference which reminds us of that between living and dead matter; and this will strike us still more forcibly when we consider some more complicated cases of rotational motion. The top, the ordinary spinning-top of the schoolboy, stands on its peg and "sleeps" in the upright position, in contempt of all the laws which govern statical equilibrium.

The experimental study of spinning-tops is carried on by very small boys and a few more or less aged people. Somehow, but I think quite wrongly, a top is regarded as a toy suitable only for a child, and that kind of amusement is scarcely encouraged by the benevolent despots who so completely direct the games of boys at school. Among older boys there used to be a regular game in Scotland of "peeries," and some of you may have read Clerk Maxwell's poetical description of the Homeric contests which distinguished the sport.

The top as a plaything is depised; nevertheless it is a most important contrivance. The earth on which we live is a top, and a considerable range of astronomical phenomena are most easily explained by reference to the behaviour of ordinary spinning-tops. It is a top that directs the dirigible torpedo, that controls the monorail car, which may soon rise from the posi-

[1] Discourse delivered at the Royal Institution on Friday, February 14, by Prof. Andrew Gray, F.R.S. The motor-gyrostats described are the invention of Dr. J. G. Gray and Mr. G. B. Burnside. The gyrostatic tops and combinations used in the latter part of the lecture are due to Dr. Gray.

tion of a small model to that of an important affair of practical railway engineering, and that in the gyrostatic compass gives a direction-pointer unaffected by the iron of the ship, or the rolling and pitching of the vessel. Its properties (summed up in what we call gyrostatic action) have to be reckoned with in all swift-running machinery, such as fast-speed turbines, and rotary engines of all kinds, especially if these drive flywheels or propellers. They affect very seriously the stability of aëroplanes, and even of submarines, and I am very doubtful if aviators have yet become in sufficient degree instinctively alive to the dangers of sudden turnings, such as those which are encouraged by the promoters of aviation displays in alighting competitions.

The man who has spun and studied tops and gyrostats appreciates as no one else can the extreme importance of properly balancing rotating machinery, and of avoiding gyrostatic action where such action is likely to interfere with the running of the machine as a whole.

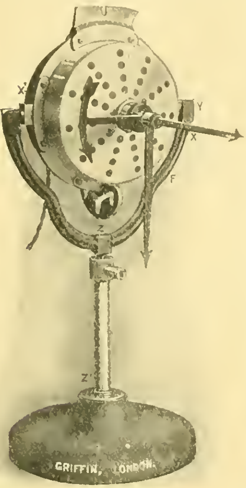


FIG. 1.—Motor-gyrostat in "fork and pedestal" mounting.

The properties of a top are best studied in the gyroscope, or gyrostat, as it is better called. Here is a simple gyrostat, of the ordinary form sold in the toyshops, but with some important modifications to enable it to run for a long time at a high speed. It consists, as you see, of a heavy-rimmed metal disc, or flywheel, capable of rotation with but little friction on pivots held in sockets attached to a metal frame. Thus the flywheel may, by the quick withdrawal of a string wound round its axle, or in some other way, be set into rapid rotation in the frame, which in turn is mounted in various ways to show gyrostatic effects. But this ordinary form, as well as some others of a more pretentious character, suffers from the great disadvantage of having no means of maintaining the spin, and the continual renewal of the spin is a great nuisance.

I have here a gyrostat (Fig. 1) in which this drawback has been overcome by the simple and effective device of making the flywheel itself the rotor of a high-speed continuous-current electric motor. The ordinary gramme-ring armature is well adapted for this. It gives a wheel of great moment of inertia, or, as I call it, "spin inertia" (that is, the matter of the wheel is distributed so as to be on the whole as distant from the axis as possible), which can be run at high speed for a long time without trouble of any kind from bearings or contacts.

For my first experiments the motor gyrostat is set up with the axis of the flywheel horizontal, in this mounting, which consists, as you see, of a fork perched on a pillar. Notice the possible motions, the freedoms, I may call them, of the arrangement. The flywheel can turn about its axle, the case can turn about the line of the pivots which carry it in the fork, and the fork about a vertical axis provided in the pillar. These three axles, which we shall number (1), (2), (3), are mutually at right angles and meet at the centre of gravity of the movable system or gyrostat proper. When thus set up the gyrostat is said to be freely mounted.

With the flywheel at rest I push down on one side of the case, and immediately turning takes place, as we should expect, about the axis (2). Pushing down the other side of the case causes the instrument to turn about the axis (2) in the opposite direction. I grasp the fork in my hands and turn it about the axle (3) in either direction. Nothing unexpected happens; the gyrostat turns with the fork, its axis remaining horizontal throughout. Again, I grasp the pillar in my hands and turn it on the table, and you see that the friction of the axle (3) is sufficient to cause the fork and gyrostat to move round with the pillar. As before, the axis of the flywheel remains horizontal.

My assistant now causes a current of electricity to flow in the coils which form part of the flywheel and in the coils which surround the soft iron core of the magnet which is stationary within the ring. So far you can only tell that the flywheel is turning by the faint hum which its motion sets up. But when I repeat the operations which I have just performed on the non-rotating gyrostat, the behaviour of the instrument is quite startlingly different. I push down on one side of the case as before; a resisting force is experienced, and the gyrostat turns, not visibly about the axle (2), but about (3), the vertical axis. So long as I maintain the tilting force so long does the resistance and this turning about the vertical persist. I withdraw the tilting force, and the turning motion ceases.

Now I would direct attention to these rods with arrow-heads, which are screwed to the gyrostat case. This curved one shows the direction in which the flywheel is spinning. The straight rods are intended to represent the spin-momentum and the tilting action respectively. Both are completely known when their amounts and their planes are known. The spin-momentum is got by multiplying two numbers together, one representing the spin-inertia of the wheel (which is greater the more the mass is placed in the rim), the other the speed of turning. The turning action or "couple" is also got by multiplying the force with which I push by the arm or leverage of the force about the axis. So then we represent these two by lines drawn at right angles to the two planes, making the lines of lengths to represent the two products. Standing on one side of the plane of the flywheel, you see it turning against the hands of a clock; standing on one side of the plane of the turning action I apply you observe that action tending to turn the body also against the hands of a clock. The two lines representing the two products drawn towards you from the two planes represent also the directions of the turning actions of the couples. For example, the direction of rotation of the flywheel being that shown by the curved rod, the line representing the spin-momentum points outwards from the side of the gyrostat to which the rods are attached. I call this the *spin-axis*. The other line representing the turning action which I applied I call the *couple-axis*.

Now observe that I set the couple-axis so as to point toward your left. I push down the side of the gyrostat nearest me, and you see that the spin-axis turns towards the left. Again, I turn the couple-axis so as to point to your right. When so placed it represents a turning action tending to depress the end of the axle of the flywheel that is nearest you. I apply such an action and the spin-axis turns towards your right. In both cases the spin-axis turned towards the instantaneous position of the couple-axis.

Now I set the couple-axis vertical, pointing up. It represents a turning action tending to produce horizontal turning in the counter-clock direction as seen from above. I apply such an action to the fork, when you see that the gyrostat turns the spin-axis towards the upward direction. Finally, I set the couple-axis vertical but pointing down, as in Fig. 1. It now represents a turning action tending to produce clockwise rotation as viewed from above, counter-clock rotation as seen from below. I apply the action represented and the gyrostat turns the spin-axis towards the downward direction.

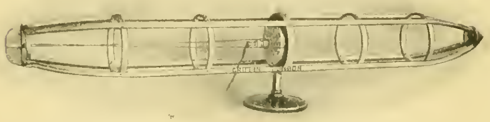


FIG. 2.—Motor-gyrostat mounted to demonstrate the principle of the dirigible torpedo.

These experiments may be summed up as follows:—The flywheel is spinning about axis (1). Any attempt to tilt the gyrostat about axis (2) produces turning about (3); an attempt to tilt it about (3) produces turning about (2). This response of the body seems paradoxical, but in point of fact, and this is the secret of the whole affair, *this turning of the body as a whole amounts to the production of spin-momentum about the couple-axis at exactly the proper rate.* It is quite easy to prove this by the consideration, in the most elementary way, of the accelerations of the different particles composing the wheel.

The turning of the spin-axis towards the couple-axis is called a precessional motion, from a similar motion of the earth which produces the astronomical phenomenon called the precession of the equinoxes. The turning action, or couple, as I shall now call it, may be said to cause the flywheel to "precess" towards the couple-axis. This relation of directions is very important, and should be kept always in mind.

If this turning response of the body, about an axis which we shall call (3), is prevented when turning about an axis (2), at right angles to (3), is changing the direction of the axis of a rotor—an axis (1), say, at right angles to (2) and (3)—a preventing couple, usually called *gyrostatic*, about the axis (3), must be applied by the bearings to the axle of the rotor, and therefore an equal and opposite couple by the axle to the bearings. This couple, it is easy to prove, is equal to the product of the spin-momentum and the angular speed at which the direction of the axis of the rotor is being changed. Thus the greater the moment of inertia of the rotor, or its angular speed, or the angular speed of the change of direction of the axis, the greater is the gyrostatic couple.

For example, the rotor of a dynamo, mounted on one of the decks with its rotor-axis athwart ship, applies, when the ship rolls, a couple to the bearings, the plane of which is parallel to the deck, and which consists of a forward force on one bearing and a sternward force on the other. These forces are reversed with reversal of the direction of rolling, so that an alternating force is applied to each bearing tending to shear it off the deck. Thus if the bearings are at all loose, the axle will knock alternately on the front and back of each bearing.

Similarly the axle of the rotor of a fore-and-aft turbine, when the ship pitches, applies a force to port to the bearing at one end, and a force to starboard at the other end, which forces are reversed when the direction of the pitching motion is reversed. When the course is being changed the forces of the gyrostatic couple are applied to the top of one bearing and the bottom of the other.

Now, returning to the pillar-gyrostat, and putting the flywheel in rapid rotation, I turn the pillar round on the table. I have turned, as you see, the base round through one revolution, and throughout the turning motion the axle of the flywheel has remained pointing in the same direction. The friction at the axle about which I have turned the pillar, which, you will remember, was sufficient to carry the gyrostat round when there was no spin, is now quite insufficient to cause any serious change of position of the gyrostat. Only a very small couple producing precession acted.

This experiment illustrates the principle of permanence of direction of the axis of rotation, in the absence of a couple producing precession, the principle on which depend the gyrostatic compass and the self-directing torpedo. Carried within the body of the torpedo is a fast-spinning gyrostat, and at the instant at which the torpedo leaves the impulse-tube this gyrostat is mounted freely with its axis coincident with that of the torpedo—that is pointed, so to speak, exactly along the "cigar." Any turning of the torpedo body sideways brings about a relative shift between the gyrostat and torpedo axes, and this shift brings into operation a vertical rudder at the stern of the torpedo. If the nose of the torpedo turns to port, the rudder steers the craft to starboard, and *vice versâ*.

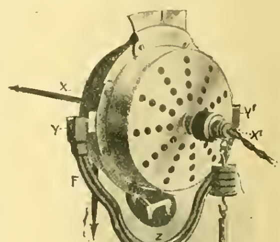


FIG. 3.—Motor-gyrostat in pedestal, with weight attached.

Here (Fig. 2) is a skeleton frame representing a torpedo. It is mounted on a vertical axle, and carried on pivots within the structure is one of our motor-gyrostats. At the stern of the frame is a small rudder, and this is connected by means of cords to the gyrostat. I set the flywheel in rotation. When, as I do now, I turn the nose of the torpedo to port, the rudder steers to starboard; when I turn the nose to starboard the rudder steers the craft to port.

The case of the pedestal gyrostat is provided with a hook at one extremity of the axis (see Fig. 3). The effect of hanging a weight on this hook is to apply a couple tending to cause turning about the axis (2)—that is, which would produce such turning if the flywheel were not spinning. But the wheel is spinning, and the visible actual turning is about the axis (3). Observe also that the wheel is rotating comparatively slowly, and that the precessional motion is great. I increase the speed of the flywheel and the gyrostat precesses more slowly. I replace the weight by a larger one, and for the same spin the precessional motion is greatly increased. Thus for a given applied couple the faster the spin the slower the precessional motion, and for a given spin the greater the couple the faster the precessional motion.

Now while the weight is in position and the gyrostat precessing about the axle (3) I attempt to hurry the precessional motion, and immediately the gyrostat turns about the axis (2) so as to *rise* against gravity. I try to delay the precession, and again the gyrostat turns about the axis (2), but now so as to descend under gravity.

Without being aware of it people are constantly meeting with examples of gyrostatic action in daily life. A child expert in trundling a hoop causes it to turn its path to the right or left, by striking it a blow at the top with the hoop stick, the effect of which the ordinary person would suppose, if he thought about it, should be to make the hoop to fall over to the right or the left. A bicyclist riding without holding the handles leans over to the right if he wants to steer the bicycle to the right, and to the left if he wants to steer to the left. And if he feels himself falling over to right or left he turns the handles instinctively so as to turn the bicycle to that side, when the machine resumes the upright position. In the bicycle, however, the spin of the wheels is not the most important action to be taken account of.

The gyrostatic action in the bicycle is much more marked in a motor machine, for in that a massive flywheel rotates in the same direction as the wheels. As the bicycle turns a corner it is constrained to precess, and a couple is needed to produce this precession of the rotating parts quite apart from that required to turn the rest of the machine. This the rider applies by leaning over to the *inside* of the turn, and leans over more than he would have to do if the flywheel were not there or were not rotating.

Good examples of gyrostatic action are given by paddle and turbine steamers. A paddle steamer is steadier in a cross-sea than a screw steamer of the same size. This is due in part to the gyrostatic action of the paddle-wheels, which, but for their comparatively slow speed of rotation, would form a compound gyrostat of considerable power. For this gyrostat the spin-momentum may be conveniently represented by a line drawn from the steamer towards the port-side. A couple tending to tilt the steamer over to starboard is represented by a line drawn towards the bow, and a couple tending to tilt the steamer to port by a line drawn towards the stern. Hence, if the steamer heels over to starboard, her bow, in consequence of gyrostatic action, precesses to starboard, but the starboard wheel, becoming somewhat more deeply immersed, uses more power and exerts a turning influence to port. Thus the steersman has less difficulty in keeping the vessel on a straight course.

But if the vessel be turned by the rudder, say to port, the vessel will by gyrostatic action be slightly heeled over to starboard, and the starboard wheel, being more deeply immersed, will assist the turning action of the rudder.

Though the gyrostatic action of the wheels is not very great, calculation shows that it is enough to produce an appreciable variation in the immersion of the wheels.

The gyrostatic action of the flywheel in a motor-car is of some practical interest. The flywheel is placed with its plane athwart the car that is, with the axis, so to speak, fore and aft. It rotates in the clockwise direction as viewed by an observer behind the car. The effect of turning a corner to the left gives a gyrostatic couple, throwing the weight of the car more on the back wheels; turning to the right throws the weight more on the front wheels. The forces applied by the ground to the front wheels are diminished in the former case and increased in the latter. There is danger, therefore, of the steering power of the car being interfered with, if the corner is taken at too great a speed.

As a final example, we take an aëroplane. Here the rotor of the engine and the propeller together form a compound gyrostat of considerable power. As the bearings are fore and aft, the action is similar to that of the flywheel of the motor-car. Turning horizontally in one direction gives rise to a gyrostatic couple tending to make the aëroplane dive, turning the opposite way sets up a couple which makes the aëroplane rear up in front. If the aëroplane is kept horizontal such couples have to be balanced by stresses in the framework. These considerations show that sudden turning of aëroplanes should, if possible, be avoided. Manœuvres calling for such turning are accompanied by very considerable danger. No doubt aviators are aware of the existence of gyrostatic action, but there is considerable haziness in people's minds as to its direction in the various possible cases. The peculiar properties of rotating bodies need not, of course, be understood theoretically by aviators, though it is well to know something about them. But the aviator, like a person walking or swimming, must know instinctively what to do in an emergency, and what motions must be avoided. The gyrostatic action he has to contend with lies hid, as it were, until he tries some new and violent manœuvre; and then it brings him to grief.

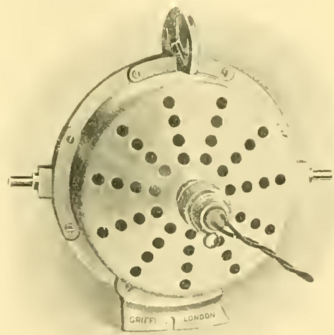


Fig. 4.—Motor-gyrostat balancing on a skate.

I now pass on to some special experiments which can be carried out with these motor-gyrostats. First take one or two old experiments (see Thomson and Tait's "Natural Philosophy," § 345[x] *et seq.*), which are more effectively performed with these fast-running instruments. Here is a skate attachment (Fig. 4) on which I place the gyrostat after its speed has been adjusted to the moderate value of about 6000 revolutions per minute. The plane of the flywheel is in-

Fig. 5.—Motor-gyrostat on gimbals

clined to the vertical, and you see that the top does not fall down, but precesses round on the table. I increase the inclination and the precession becomes more rapid. Now I attempt to hurry the precession, and the gyrostat stands up erect; I try to resist the precession and the gyrostat falls over.

I mount the gyrostat with its wheel horizontal over

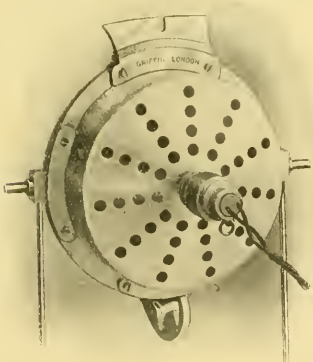


Fig. 6.—Motor-gyrostat balancing on stilts.

a flexible support, in the present case a universal joint (Fig. 5). Without rotation the instrument would fall over at once, but you see that it stands stably erect when the flywheel is spinning, and has a precessional motion when disturbed from the upright position.

Again, here is a two-stilt support (Fig. 6). One of the stilts is held by a long socket, at one side of the case, and may be regarded as rigidly attached. The other stilt is simply a bit of wire pointed at both ends; one end rests on the table, the other, the upper end, rests loosely in a hollow in the under-side of this projecting piece attached to the case. The gyrostat is thus supported between two stilts, one fixed the other quite loose, and its axis is at right angles to the plane of these when the arrangement stands upright. It would be hard to devise a more unstable support. You see that there is no possibility of making the arrangement stand up without spin. But you see, on the other hand, that there is a fair amount of stability with the flywheel spinning if the arrangement is allowed to oscillate, or, as one might say, wriggle, backwards and forwards, horizontally.

In the next experiment (due originally, I have been told, to the late Prof. Blackburn) the gyrostat is rigidly

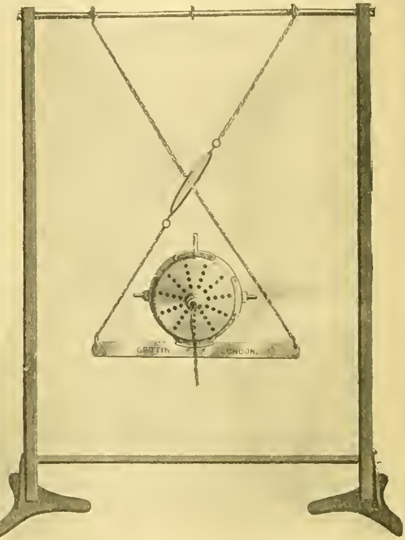


Fig. 7.—Motor-gyrostat on crossed bifilar support.

clamped to this metal bar, which, as you see, is hung by two chains attached to its ends. The chains have been crossed by passing one through a large ring in the middle of the other. I turn the gyrostat so that the chains and the rim of the case are in the vertical plane. You observe that the arrangement is one of instability. The gyrostat has perfect freedom to fall over towards you, or towards me. Further, in consequence of the crossing of the chains the gyrostat is unstable as regards motion about a vertical axis. The arrangement is thus doubly unstable without rotation.

I now set the flywheel into rapid rotation, arrange the instrument as before, and leave it to itself, when, as you observe, it balances with great ease.

I now repeat the experiment with the chains uncrossed. Here there is only one instability without rotation, and you observe that the gyrostat falls over. An important point to be observed here is that the rotation will completely stabilise two non-rotational instabilities but not one. In point of fact, a system possessing non-rotational freedoms, all of which are unstable, can be completely stabilised if the number of freedoms is even, but not if the number is odd.

A general explanation of the experiment just performed may be given, as follows. Starting with the bar, gyrostat rim, and chains (crossed) in one vertical plane, we may suppose the gyrostat to fall over slightly. In consequence of the tilting couple introduced the gyrostat precesses so that its axis turns in a plane which is nearly horizontal. The chains now get slightly out of the vertical, and at once a couple hurrying the precessional motion is brought to bear on the gyrostat, which, in consequence, erects itself into the vertical position. The couple does not retard but hurries the precession because the chains are crossed. This holds for both directions in which it is possible for the gyrostat to fall over. Again, suppose, starting with the rim, bar, and chain in the same vertical plane, the chains get out of the vertical. There is now a couple brought to bear on the gyrostat tending to turn its axis in a horizontal plane. In consequence the gyrostat tilts over on the bar—in other words, it has a precessional motion about a horizontal axis in the plane of the flywheel. This brings into action a couple due to gravity, which is such as to hurry the last-mentioned precessional motion; the horizontal motion is opposed and reversed, and with the reversal the gyrostat regains the upright position. This holds for both directions in which the bar tends to turn in consequence of the crossed chains. The result is complete stability.

Similar explanations are applicable to the other cases of motion you have seen.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE foundation-stone of the new building of the agricultural department at Armstrong College, Newcastle-upon-Tyne, was laid on April 5, by Dr. C. Stephenson, of Newcastle, whose gift of 5000*l.* enabled the college council to cooperate with the Board of Agriculture in a scheme proposed by the Development Commissioners. The new block of buildings has three floors, and includes administrative offices, class-rooms, laboratories for botany and zoology, a museum, research laboratories, &c.

IT is proposed to hold a short spring holiday course in science at the University of Leeds on Thursday, Friday, and Saturday, April 24, 25, and 26. The course is designed primarily for teachers who wish to keep in touch with modern scientific work, but it will also afford an opportunity for all who are interested to meet and discuss among themselves, and with members of the University staff, the problems which arise in their teaching and research. In the department of physics Prof. Bragg will give three lectures on radioactivity and its lessons, Dr. N. R. Campbell two lectures on the electron theory, Mr. A. O. Allen one lecture on modern technical optics, and Mr. S. A. Shorter one lecture on capillarity. In the department of chemistry Dr. H. M. Dawson will give three lectures on recent work in physical chemistry. The fee for the course is 10*s.*, but graduates of the University of Leeds will be admitted free.

A DEPUTATION urging the views expressed at the recent Eugenic Education Conference was received by Mr. Trevelyan, Parliamentary Secretary of the Board of Education, on April 2. Among the speakers were Major L. Darwin, president of the Eugenics Education Society, and the Headmaster of Eton. The deputation presented the following resolution, which was passed at the conference:—"That the Minister of Education be asked to receive a deputation requesting an inquiry as to the advisability of encouraging the presentation of the idea of racial responsibility to students in training, and children at school." It was indicated that there is no idea of advocating the addition of "eugenics" as an extra subject in the curriculum, or of requiring it to be taught by unwilling teachers. It was urged that if the idea of individual racial responsibility were inculcated by means of presenting the eugenic ideal, and the subject approached from the evolutionary point of view, it would both assist the teachers and tend to strengthen the moral tone of the country; and also that the training-college curriculum should be adapted to include the necessary biological and physiological knowledge on which the eugenic ideal can be based. Mr. Trevelyan expressed his sympathy with the general objects which the deputation put before him. He said the Board of Education has no wish to discourage any experiments in teaching on these lines, and recognises the importance of the matter, and will consider carefully the representations made by the deputation.

AT a meeting of the Society of Engineers (Incorporated), held on Monday, April 7, Mr. W. Ransom read a paper on how to improve the status of engineers and engineering, with special reference to consulting engineers. He pointed out that the civilisation of to-day has become possible only because of the efforts of the engineer, but that the public does not sufficiently appreciate the advantages it has gained or the men whose work has secured these advantages. Engineers have many lessons to learn from the legal and medical professions, both of which exclude unqualified men and exercise a benevolent professional control over their members; and the State should recognise the engineering profession by giving it an official standing equal to that of other professions. Admission to the profession requires to be carefully guarded, and the number of pupils allowed to an engineer should be regulated by the extent of his practice, while the climax of the period of pupilage should be a State examination. Much more may be done to make examinations of practical value to those who prepare for them, but no other form of test is possible. When State recognition is obtained for engineers, the members of the profession will constitute one great society, amalgamating the existing societies into one body, which should have the control of professional matters and be the mouthpiece of the profession. Such a society would necessarily have subsections dealing with special branches of the profession. While the growth of specialisation must be recognised, it is essential for those who are training for the profession to acquire a sound general scientific knowledge before beginning to specialise.

THE following are among the courses of advanced lectures upon scientific subjects announced in the *London University Gazette* of *April* 2:—Six lectures on the activities of plants in relation to light, at Bedford College, by Harold W. T. Wager, F.R.S., on April 28, May 5, 19, 26, June 2 and 9; three lectures on geological problems of the desert, at University College, by Dr. J. Walther, professor of geology in the University of Halle, on April 23, 24, and 25; eight lectures on surface tension and physiological processes, by Prof. A. B. Macallum, F.R.S., at the

University, beginning on May 13; eight lectures on the physiology of photosynthesis and respiration in plants, by F. F. Blackman, F.R.S., at University College, beginning on April 23; four lectures on the physiology of absorption, by Prof. T. G. Brodie, F.R.S., at King's College, beginning on May 21; four lectures on the supposed physical basis of life and mind, by Dr. J. S. Haldane, F.R.S., at Guy's Hospital, beginning on May 8; eight lectures on the factors concerned in the volume and form changes of cells (growth and movement), by Dr. H. E. Roaf, at St. Mary's Hospital Medical School, beginning on May 5; three lectures on growth and form, by Prof. D'Arcy W. Thompson, C.B., at King's College, on May 26, 28, and 30; four lectures on recent advances in the metallurgy of copper, gold, silver, and lead, by Prof. W. Gowland, F.R.S., at the Old Royal College of Science Building, South Kensington, on April 21, 25, 28, and May 2. The lectures are for advanced students of the University and others interested in the various subjects. Admission to all the lectures except those on physiology is free, without ticket.

The report of the Admiralty Committee appointed to inquire into the education and training of naval officers shows that the Admiralty policy of watching the results of its great educational experiment with the view of readjusting its procedure to meet any defects that may be revealed, is being consistently and carefully carried out. The recommendations of the Committee that are of most general interest may be thus summarised:—(1) That to increase the number of candidates for entry and so raise the standard of ability among those selected, a system of bursaries or reduced fees shall be established, which for not more than 20 per cent. of any entry would reduce the annual cost of the four years of training at Osborne and Dartmouth from about 110*l.* per annum to about 59*l.* per annum. (2) That the subsequent training of cadets in special seagoing cruisers before joining the fleet be reduced from eight months to four. (3) That all sub-lieutenants shall serve six consecutive months in the engine-room department and obtain an engine-room watch-keeping certificate. (4) That officers who volunteer for the engineering branch shall pass through a course of study lasting six months at Greenwich, followed by a practical course of about one year's duration at Keyham. (5) That for the higher technical and administrative engineering appointments at the Admiralty and dockyards a selection be made of a limited number of those who have qualified for the engineering branch. These officers will undergo a further two years' training at Greenwich, followed by not less than one year at sea, after which they will be eligible for special shore appointments, but will not be eligible to take military command. Changes in the training of specialists in navigation, torpedo, and gunnery are also recommended with the view of securing earlier practical efficiency in the duties to be actually performed at sea.

SOCIETIES AND ACADEMIES.

Edinburgh.

Royal Society, March 17.—Dr. B. N. Peach, F.R.S., vice-president, in the chair.—Dr. W. S. **Bruce**: Measurements and weights of Antarctic seals taken by the Scottish National Antarctic expedition.—Dr. S. F. **Harmer** and Dr. W. G. **Ridewood**: The Pterobranchia of the Scottish National Antarctic expedition. The paper contained the description of a new species of Cephalodiscus (*C. agglutinans*), in which the colony is massive and branching, the pieces of the colony being 115 mm. in greatest length, and 55 mm. in greatest breadth. The specimens were obtained in one haul in 56 fathoms off the Burdwood Bank, south of the Falkland Islands. The Zooids, which are deep brown or black in colour, are 4·5 mm. long, and have usually nine pairs of arms, *i.e.* a greater number than in any species hitherto known. Buds are present in large numbers, being formed in the usual way on a disc at the end of a stalk of a full-grown individual.—Prof. J. **Stephenson**: Intestinal respiration in Annelids, with considerations on the origin and evolution of the vascular system in that group. The occurrence of antiperistalsis and ascending ciliary action in the intestine of aquatic Oligochæta points to the intestine being a respiratory organ in those worms. The exceptional case of the genus Chætogaster is explained by assuming the descent of existing species (which are carnivorous) from endoparasitic ancestors, the antiperistalsis and the ascending ciliary action being given up on the assumption of the parasitic habit. From a consideration of the cryptozoic habits, the nature of the vascular system, and the occurrence of intestinal respiration, the author holds that the existing Polychæts are to be regarded as more primitive than the errant forms.—Dr. J. **Ritchie** and A. J. H. **Edwards**: The occurrence of functional teeth in the upper jaw of the sperm whale. In two of seven sperm whales examined about a score of maxillary teeth, with worn crowns, projected from the surface of the gum and were clearly used in masticating. Each of the whales had an enormous pre-oral rostrum sharply truncated at the extremity.

Paris.

Academy of Sciences, March 25.—M. F. Guyon in the chair.—Gaston **Darboux**: Minimal surfaces engendered by a variable circle.—A. **Laveran** and M. **Marullaz**: Concerning some toxoplasms of the rabbit and gondi (*Ctenodactylus gondi*). Splendore described a new protozoa (*Toxoplasma cuniculi*) affecting rabbits, and Nicolle and Manceaux have isolated a very similar organism (*T. gondi*) from the gondi of Tunis. The experiments on rabbits described by the author lead to the conclusion that the two protozoa are probably identical, although this is not yet conclusively proved.—The president announced the death of Louis Henry, correspondant for the section of chemistry.—R. **Jonckheère**: New double stars discovered at the Observatory of Lille. Since 1906 thirteen lists have been given describing the positions of 1002 new double stars of an average magnitude of 9·19.—Jules **Andrade**: New experimental researches on double spiral balance springs.—L. **Décombe**: The electronic theory of gravitation.—Mlle. Paule **Collet**: The electrical conductivity of tellurium. The direction of the crystalline axes was without effect on the resistance. The influence of pressure, of the time of passage of the current, and of the applied electromotive force has been studied, and also the residual electromotive forces in the tellurium.—H. **Buisson** and C. H. **Fabry**: The wave-lengths of the krypton lines. The krypton lines are extremely fine and permit interferences up to the order of 600,000, or even of 950,000 if the tube is cooled in a bath of liquid air, corresponding to a difference of path of 53 cm. The green and yellow krypton lines have been compared with the red cadmium line, and, taking the data given by Benoit, Fabry, and Perot for the latter, the krypton lines are evaluated as 5570·2908 and 5870·9172, with an approximation of some units in the last figure. The krypton tube has the advantage of working without heating, and the two lines can be separated without the use of any apparatus for dispersion by the use of suitable absorbing solutions (didymium chloride for the yellow ray, eosin for the green ray).—M. **Dussaud**: The separation of the lighting and heating effects produced by a source of light. Instead of concentration by single lenses, a group of optical systems arranged to succeed each other automatically is used. During displacement out of the path of the rays, the system cools. In this way a separation of the heating and lighting effects is produced. Numerous applications are suggested.—Mlle. L. **Chevroton** and M. F. **Vlès**: Kinematography of the vocal chords and their laryngial annexes.—G. **Lafon**: The formation of fat at the expense of the albuminoid materials in the animal organism. The formation of fat from albuminoid material, although theoretically possible, is physiologically difficult. The nutritive value of albumin, considered as a source of energy, must be measured, not by the total energy it contains, but by the energy contained in the amount of glucose which can be derived from it.—P. **Chaussé**: The conditions of respirability of the virulent particles obtained by liquid polarisation. In experimental infection by the inhalation of liquid tuberculous virus, it is only the dried particles which are effective.—Em. **Bourquelot** and Em. **Verdon**: The reversibility of ferment actions: emulsin and β-methylglucoside. The action of emulsin upon β-methylglucoside and upon a mixture of glucose and methylglucoside shows that the reaction is reversible, the final state of equilibrium being identical in both systems.—R. **Goupil**: Researches on the phosphorus compounds formed by *Amylomyces rouxii*.—L. **Launoy** and K. **Oechslin**: Concerning secretin (Bayliss and Starling) and vasodilatine (Popielski). By repeated precipitation with absolute alcohol secretin can be obtained possessing no depressive action on the blood pressure; a depressor substance has also been isolated from the alcoholic solutions, for which the name depressine is proposed. These results are in agreement with the views of Bayliss and Starling, and opposed to those of Popielski.—Louis **Gentil**: The structure of the coast line of western Algeria.

March 31.—M. F. Guyon in the chair.—Gaston **Darboux**: Minimum surfaces engendered by a variable circle. Emile **Picard**: A class of transcendentals generalising elliptic and Abelian functions.—J. **Boussinesq**: The existence of a superficial viscosity in the thin transition layer separating a liquid from another fluid.—MM. **Leclainche** and **Vallée**: Vaccination against anthrax. Details of a method of obtaining with certainty attenuated races of the anthrax bacillus. More than 345,000 successful inoculations have been made with this virus during the last three years.—The secretary announced the death of V. Dwelshauvers-Dery, correspondant for the section of mechanics.—M. **Amann**: Observations of the mutual occultations of the satellites of Jupiter.—Léon **Lichtenstein**: The fundamental functions of linear differential equations of the second order and the development of an arbitrary function. Application of the theory of quadratic forms to an infinity of variables.—Georges **Pólya**: A theorem of Laguerre.—M. **Barré**: A series of surfaces of which a family of lines of curvature is constituted by indeformable helices.—Henri **Bénard**: The zone of formation of alternate vortices behind an obstacle.—Ernest **Esclangon**: The motion of the support in pendulum observations.—J. **Chaudier**: The magnetic rotatory polarisation of liquefied oxygen and nitrogen.—M. de **Broglie**: The multiple images produced by Röntgen rays after traversing crystals.—Victor **Henri** and René **Wurmser**: The energy absorbed in photochemical reactions. In the three cases examined experimentally the energy necessary for the destruction of a molecule is less than the quantum of energy of Einstein.—L. **Gay**: The pressure of expansibility of normal fluids.—M. **Barre**: Combinations of cerium chloride with ammonia gas. Five definite compounds are described, all of which are decomposed by water.—A. **Saint-Sernin**: The estimation of calcium as tungstate. The determination of calcium as tungstate possesses some advantages, especially as regards its separation from magnesium.—E. **Chablay**: The preparation of the primary alcohols by reducing the esters by means of absolute alcohol and sodammonium. The ester R.CO.(OR′) is converted by this reaction into the alcohol $R.CH_2.(OH)$. Examples of the generality of the reaction are given.—A. **Duffour**: A new crystalline form of potassium bichromate.—L. **Blaringhem**: A remarkable case of heredity in hybrids of barley, *Hordeum distichum nutans* × *H. distichum nudum*.—Albert **Berthelot** and D. M. **Bertrand**: Researches on the intestinal flora. The possible production of ptomaines in acid medium. In the intestinal flora of subjects showing symptoms of enteritis or of mucocolitis, together with fœcal matter possessing an acid reaction, an organism is frequently found (*B. aminophilus intestinalis*) capable of removing the carboxyl group from histidine even in a slightly acid medium.—M. **Mansuy**: Limestones of Indo-China containing Productus.—Gustave F. **Dollfus**: The use of drainage wells. The attempt to modify the flooding of the Seine valley by borings is useless, and likely to aggravate the trouble it is intended to alleviate.

BOOKS RECEIVED.

Paläobotanisches Praktikum. By Prof. H. Potonie and Dr. W. Gothan. Pp. viii+152. (Berlin: Gebrüder Borntraeger.) 4 marks.

Modern Geography for High Schools. By R. D. Salisbury, H. H. Barrows, and W. S. Tower. Pp. ix+418+vii plates. (New York: H. Holt and Co.) 1.25 dollars.

Der Mensch und seine Kultur. By Neophilosophos Tis. Pp. 101. (Konstanz: E. Ackermann.) 3 marks.

Theorie der Erdgestalt nach Gesetzen der Hydrostatik. By Clairaut. Edited by P. E. B. Jourdain and A. v. Oettingen. Pp. 162. (Leipzig: W. Engelmann.) 4.60 marks.

Die Druckkräfte des Lichtes. By P. Lebedew. Edited by P. Lasareff. Pp. 58. (Leipzig: W. Engelmann.) 1.80 marks.

Dispersion und Absorption des Lichtes in ruhenden isotropen Körpern. By Dr. D. A. Goldhammer. Pp. vi+144. (Leipzig u. Berlin: B. G. Teubner.) 3.60 marks.

Ministry of Finance, Egypt. Survey Department. Meteorological Report for the Year 1910. Part ii., Climatological and Rainfall Observations. Pp. 199+ii plates. (Cairo: Government Press.) 15 P.T.

Examples in Algebra. By H. S. Hall. Pp. viii+168+xxxvii. (London: Macmillan and Co., Ltd.) 2*s*.

Elementary Biology: Plant, Animal, Human. By J. E. Peabody and A. E. Hunt. (London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

Die Vererbung und Bestimmung des Geschlechtes. By C. Correns and R. Goldschmidt. Erweiterte Fassung. Pp. viii+149+plates. (Berlin: Gebrüder Borntraeger.) 4.50 marks.

Tracks of the Sun and Stars, A.D. 1900 to A.D. 37900. By T. E. Heath. Pp. 17+vi. (London: W. Wesley and Son.) 5*s*. net.

Are the Planets Inhabited? By E. W. Maunder. Pp. iv+166. (London: Harper and Brothers.) 2*s*. 6*d*. net.

The Age of the Earth. By A. Holmes. Pp. xii+196. (London: Harper and Brothers.) 2*s*. 6*d*. net.

Service Chemistry. By Prof. V. B. Lewes and

J. S. S. Brame. Fourth edition, revised. Pp. xvi+576+vii plates. (London: E. Arnold.) 15s. net.

Canada. Department of Mines. Mines Branch. Pyrites in Canada. By Dr. A. W. G. Wilson. Pp. xi+202. (Ottawa: Government Printing Bureau.)

The Sling. By W. L. Jordan. Second edition. Pp vi+431. (London: Simpkin and Co., Ltd.) 7s. 6d. net.

Mimikry und verwandte Erscheinungen. By Dr. A. Jacobi. Pp. ix+215. (Braunschweig: F. Vieweg und Sohn.)

The Geology and Mining Industry of the Kinta District, Perak, Federated Malay States, with a Geological Sketch Map. By J. B. Scrivenor. Pp. viii+90+20 plates. (Kuala Lumpur: F.M.S. Government Printing Office.) 3 dollars.

Annals of the South African Museum. Vol. vii., part 6, pp. 353–366. Vol. xi., part 5, pp. 321–463. (London: West, Newman and Co.) 1s. and 15s. respectively.

Cours de Chimie Organique. By Prof. F. Swarts. 2e édition. Pp. 754. (Gand: A. Hoste; Paris: A. Hermann et Fils.) 15 francs.

Leçons sur les Hypothèses Cosmogoniques. By H. Poincaré. Seconde édition. Pp. lxx+294. (Paris: Hermann et Fils.) 12 francs.

Cours de Physique Générale. By H. Ollivier. Tome second. Pp. 295. (Paris: A. Hermann et Fils.) 10 francs.

Principia Mathematica. By Dr. A. N. Whitehead and B. Russell. Vol. iii. Pp. x+491. (Cambridge University Press.) 21s. net.

The Carnegie Foundation for the Advancement of Teaching. Seventh Annual Report of the President and of the Treasurer. Pp. vi+194. (New York City.)

Ministry of Finance. Survey Department, Egypt. The Geography and Geology of South-Eastern Egypt. By Dr. J. Ball. Pp. xii+394+xxviii plates. (Cairo: Government Press.) 40 P.T.

DIARY OF SOCIETIES.

THURSDAY, APRIL 10.

ROYAL SOCIETY, at 4.30.—The Effect of Lability (Resilience) of the Arterial Wall on the Blood Pressure and Pulse Curve: L. Hill and M. Flack.—The Nature of the Toxic Action of the Electric Discharge upon *Bacillus coli communis*: Prof. J. H. Priestley and R. C. Knight.—Some Investigations on the Phenomena of "Clot" Formations. I. The Clotting of Milk: S. B. Schryver.—(1) Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. II. The Wild Game Strain; (2) Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. III. The Wild *Glossina morsitans* Strain; (3) Infectivity of *Glossina morsitans* in Nyasaland: Surg.-General Sir D. Bruce, Majors D. Harvey and A. E. Hamerton, and Lady Bruce.

ROYAL INSTITUTION, at 3.—Colour in Flowers: Dr. E. Frankland Armstrong.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8. — Self-synchronising Machines (Self-starting Synchronous Motors and Rotary Converters): Dr E. Rosenberg.

CONCRETE INSTITUTE, at 7.30.—Structural Engineering: E. F. Etchells.

FRIDAY, APRIL 11.

ROYAL INSTITUTION, at 9.—The Winds in the Free Air: C. J. P. Cave.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Observations of the Variable Star 97.1910 Cygni: E. E. Barnard.—A Discussion of the Empirical Terms in the Moon's Longitude: E. W. Brown.—Some Types of Prominences associated with Sun-spots: Mrs. M. A. Evershed.—*Probable Papers*: The Short Period Variable SW Draconis: C. Martin and H. C. Plummer.—Preliminary Discussion of Galactic Motions of Bright Stars of Type I, with Some Additional Material (Stellar Motions, No. 5): H. C. Plummer.—Sun-spots and Terrestrial Magnetic Phenomena, 1898–1911; Sun-spot Areas, Magnetic Storms, and the Sun's Corona: Rev. A. L. Cortie.—The Distribution in Space of the Stars of Carrington's Circumpolar Catalogue (Second Paper): F. W. Dyson.—A Suggested Substitute for Bode's Law: Miss M. A. Blagg.

PHYSICAL SOCIETY, at 8.—Some Errors in Magnetic Testing Due to Elastic Strain: A. Campbell and H. C. Booth.—Note on Kathodic Spluttering: Dr. G. W. C. Kaye.

MONDAY, APRIL 14.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

ROYAL SOCIETY OF ARTS, at 8.—Aëronautics: Prof. J. E. Petavel.

TUESDAY, APRIL 15.

ROYAL INSTITUTION, at 3.—The Heredity of Sex and Some Cognate Problems: Prof. W. Bateson.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Standard Clauses for Inclusion in a Specification of Street-lighting: A. P. Trotter.

ROYAL STATISTICAL SOCIETY, at 5.—Gleanings from the Census of Production Report: A. W. Flux.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Coastal Sand-travel near Madras Harbour: Sir F. J. E. Spring.

WEDNESDAY, APRIL 16.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Vertical Distribution of Temperature in the Atmosphere, and the work required to alter it: W. H. Dines.—Report on the Phenological Observations for 1912: J. E. Clark and R. H. Hooker.—Meteorological, Electrical and Magnetic Observations during the Solar Eclipse, April 17, 1912: R. Corless, G. Dobson, and Dr. C. Chree.

ROYAL SOCIETY OF ARTS, at 8.—The Physical Properties of Clay: W. C. Hancock.

THURSDAY, APRIL 17.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Luminosity Curves of Persons having Normal and Abnormal Colour Vision: Dr. W. Watson.—A Fluorescence Spectrum of Iodine Vapour: Prof. J. C. McLennan.—The Relation between the Crystal-symmetry of the Simpler Organic Compounds and their Molecular Constitution. I.: Dr. W. Wahl.—The Purification of Phosphorus Pentoxide for Use in High Vacua: J. J. Manley.

ROYAL INSTITUTION, at 3.—The Progress of Hittite Studies. I. Recent Explorations: Prof. J. Garstang.

INSTITUTION OF MINING AND METALLURGY, at 8.

ROYAL SOCIETY OF ARTS, at 4.30.—The Burma Oil Fields: N. G. Cholmeley

FRIDAY, APRIL 18.

ROYAL INSTITUTION, at 9.—Applications of Polarised Light: Dr. T. M. Lowry.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Presidential Address.—*Discussion*: Volute Chambers and Guide-passages for Centrifugal Pumps: Prof. Gibson.

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Editorial and Publishing Offices:
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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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NOTICE.

The issue of *NATURE* for Thursday next, April 24, will contain the Index to Vol. 90.
Its price will be One Shilling.

***** Advertisements intended for the number should reach the publishers by the morning of Tuesday, April 22.**

Office: ST. MARTIN S STREET, LONDON, W.C.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BURLINGTON HOUSE, LONDON, W.

The ANNUAL MEETING of the ASSOCIATION will be held in BIRMINGHAM, beginning on WEDNESDAY, SEPTEMBER 10, 1913.

PRESIDENT-ELECT:

SIR OLIVER J. LODGE, D.Sc., LL.D., F.R.S.

SECTIONAL PRESIDENTS:

A.—Mathematical and Physical Science, H. F. BAKER, Sc.D., F.R.S.; B.—Chemistry, Prof. W. P. WYNNE, D.Sc., F.R.S.; C.—Geology, Prof. E. J. GARWOOD, M.A.; D.—Zoology, H. F. GADOW, M.A., Ph.D., F.R.S.; E.—Geography, Prof. H. N. DICKSON, D.Sc.; F.—Economic Science, Rev. P. H. WICKSTEED, M.A.; G.—Engineering, J. A. F. ASPINALL, M.Eng.; H.—Anthropology, SIR RICHARD TEMPLE, Bart., C.I.E.; I.—Physiology, F. GOWLAND HOPKINS, M.A., D.Sc., F.R.S.; K.—Botany, MISS ETHEL SARGANT; L.—Education, Principal E. H. GRIFFITHS, M.A., D.Sc., F.R.S.; M.—Agriculture, Prof. T. B. WOOD, M.A.

SECTIONAL PROCEEDINGS.

The Organising Committees are now considering contributions for the Sectional Proceedings. These should be addressed to the Recorders of the respective Sections or to the General Secretaries of the Association. Each paper must be accompanied by a brief descriptive abstract.

Reports on the State of Science, and on researches entrusted to individuals or Committees, should reach the Assistant Secretary by August 4, *at latest*, for presentation to the Organising Committees, accompanied by a statement as to whether the author will be present at the Annual Meeting.

CONDITIONS AND PRIVILEGES OF MEMBERSHIP.

New Members and Associates may be enrolled by applying to the General Treasurer, Burlington House, London, W., or to the Local Hon. Treasurers, British Association, Council House, Birmingham, on the following terms:—

I. New *Life Members* for a composition of £10, which entitles them to receive gratuitously the Reports of the Association that may be published after the date of their admission.

II. New *Annual Members* for a payment of £2 for the first year. They receive gratuitously the Report for the year of their admission, and for every following year in which they continue to pay a subscription of £1 *without intermission*.

III. *Associates* for this Meeting only for a payment of £1. They are entitled to receive the Report of the Meeting at two-thirds of the publication price. Associates are *not eligible* to serve on Committees or to hold office.

Persons who have in any former year been admitted Members of the Association may take up their *membership*, without being called upon for arrears, on payment of £1. They will not, however, be entitled to receive the Annual Report gratuitously.

Ladies may become Members or Associates, or can obtain Ladies' Tickets (transferable to Ladies only) on payment of £1.

WITHOUT AN OFFICIAL TICKET NO PERSON WILL BE ADMITTED TO ANY MEETING OF THE ASSOCIATION.

O. J. R. HOWARTH, Assistant Secretary.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY,

S. KENSINGTON.

The following Advanced Course of Lectures with practical work will be given, commencing May 14 next:—

Subject.	*Conducted by*
Radio-Activity.	Professor the Hon. R. J. STRUTT, M A., F.R.S.

For further particulars and for admission to the Course, application should be made to the SECRETARY.

BROWNING 4-PRISM TABLE

SPECTROSCOPE, with divided scale and vernier. £25.—C. BAKER, 244 High Holborn, London.

UNIVERSITY OF LONDON.

A Course of Four Lectures on "Recent Advances in the Metallurgy of Copper, Gold, Silver, and Lead" will be delivered by Professor W. GOWLAND, F.R.S., at the Imperial College, Royal College of Science, Exhibition Road, S.W., at 3 p.m., on April 21, 25, 28, and May 2, 1913. Admission free, without ticket.

P. J. HARTOG, Academic Registrar.

UNIVERSITY OF LONDON.

A Course of Three Lectures on "Geological Problems of the Desert" will be delivered by Professor JOHANNES WALTHER, of the University of Halle, at University College, Gower Street, W.C., at 4.30 p.m., on Wednesday, April 23, Thursday, April 24, and Friday, April 25. Admission free, without ticket.

P. J. HARTOG, Academic Registrar.

UNIVERSITY OF LONDON.

An Advanced Course of Eight Lectures on "The Physiology of Photosynthesis and Respiration in Plants" will be delivered by F. F. BLACKMAN, D.Sc., F.R.S., in the Institute of Physiology, University College, Gower Street, W.C., on Wednesdays at 5 p.m., beginning April 23, 1913. Admission free, without ticket.

P. J. HARTOG, Academic Registrar.

UNIVERSITY OF LONDON.

An Advanced Course of Eight Lectures on "The Factors concerned in the Volume and Form Changes of Cells (Growth and Movement)" will be delivered by H. E. ROAF, M.D., D.Sc., in the Physiological Theatre of St. Mary's Hospital Medical School on Mondays at 4 p.m., beginning May 5, 1913. Admission free, without ticket.

P. J. HARTOG, Academic Registrar.

UNIVERSITY OF LONDON.—KING'S COLLEGE.

DEPARTMENT OF PUBLIC HEALTH AND BACTERIOLOGY,
62 CHANDOS STREET, CHARING CROSS, W.C.

Professors SIMPSON and HEWLETT with the following Staff:—

Hygiene and Public Health	Dr. SOMMERVILLE, Dr. ROACH, Dr. ROUTLEY (Medical Officer of Health, Aldershot), and Col. KING, C.I.E., I.M.S. (retired).
Bacteriology and Parasitology	Dr. TAYLOR, Mr. CHARLES, Dr. LOW, and Dr. HARE.
Microscopy	Mr. J. E. BARNARD.

The new Laboratories are now completed, and are open on weekdays daily from 10 to 5 (Saturdays excepted) for instruction and Research.

Lectures and practical instruction for Examinations for the DIPLOMA OF PUBLIC HEALTH.

Special Courses are also given on applied Hygiene in the Tropics, School Hygiene for Medical Officers, Diagnosis and Control of Tuberculosis, Medical and Industrial Bacteriology, Microscopy, and other subjects.

Weekly Demonstrations are given on Sanitary Appliances, and excursions are made to places of Sanitary interest.

Arrangements are made to suit the convenience of those engaged in practice, and for those who do not require to take out the full course.

Special facilities are provided for Research and Investigations.

For further particulars apply personally, or in writing, to Professors SIMPSON or HEWLETT, at the Laboratories, or to the SECRETARY, King's College, Strand, W.C.

BATTERSEA POLYTECHNIC,

LONDON, S.W.

1. The Governing Body will proceed during the Summer to award, for next Session, the following Scholarships:—

One MORGAN SCHOLARSHIP of £60 per annum, tenable for one year, for post-graduate or research students.

Two EDWIN TATE SCHOLARSHIPS of £30 and £20 per annum respectively, each tenable for three years, in Engineering or Science.

One MAY EDWARD TATE SCHOLARSHIP of £30 per annum, tenable for three years, in the Domestic Science or Physical Training Department for Women.

Forms of entry, date of examinations, &c., may be obtained upon application to the SECRETARY.

2. A SUMMER COURSE IN PLANT PHYSIOLOGY will be held on Saturday mornings during the Summer Term.

Lecture, 10 to 11. Practical, 11 to 12.30. Fee for Course, April 26 to July 28, 5*s*.

Students attending this Course may attend the Excursions for the Study of Plant Ecology, which are held on certain Saturday afternoons.

A COURSE OF SIX LECTURES on TESTING OF DISINFECTANTS, followed by laboratory work, will be given on Friday evenings, commencing April 25, from 7 to 9.30, by Mr. J. H. JOHNSTON, M.Sc., F.I.C. Syllabus: Types of Disinfectants; Chemical Composition and Analysis; Bacteriological Tests; Standardisation of Disinfectants. Fee, 5*s*.

LONDON HOSPITAL MEDICAL COLLEGE AND DENTAL SCHOOL.

The SUMMER SESSION OPENS on MAY 1.

Students entering then are eligible to compete for the ENTRANCE SCHOLARSHIPS offered in September.

For prospectus and full information apply to the Dean (Professor WILLIAM WRIGHT, M.B., D.Sc., F.R.C.S.), who will be glad to make arrangements for anyone wishing to see over the Medical College and Dental School, Mile End, E.

THURSDAY, APRIL 17, 1913.

A TEXT-BOOK OF HUMAN PHYSIOLOGY.

Physiologie des Menschen. By Prof. Luigi Luciani. Ins Deutsche übertragen und bearbeitet von Prof. S. Baglioni und Dr. H. Winterstein, mit einer Einführung von Prof. M. Verworn. Lieferung elfte-fünfzehnte. Pp. 1–782+viii. (Jena: Gustav Fischer, 1908–1911.) Price 4 marks each.

THE present five parts complete the German version of Luciani's "Text-book of Human Physiology." The first part opens with the general physiology of sensation, giving a brief but adequate critical review of Johannes Müller's doctrine of specific nerve energies, and of Weber and Fechner's psycho-physical law governing the quantitative relationship between stimulus and sensation. The greater part of the fifty-one pages composing the first chapter is devoted to cutaneous sensations. The second chapter, occupying more than sixty pages, deals with internal and visceral sensations. While the exposition is full of detail and interest, it would have gained in clearness by a more thorough account of the classification of cutaneous and deep sensations suggested by Head and Rivers. The second chapter closes with an excellent account of the labyrinthine sensations.

The sense of taste forms the subject-matter of the third chapter, and occupies more than thirty pages. The survey given is exceptionally interesting and complete, and is well illustrated by plates. The fourth chapter is devoted to the sense of smell, and is prefaced by a brief description of the structural features of the organ of smell. The very large number of qualitative variations in odours renders the classification of olfactory sensations an almost impossible task. The author gives a very interesting and critical account of the classifications attempted by Linné and Zwaardemaker.

Nearly eighty pages are given up to the sense of hearing, which occupies the fifth chapter. It is impossible in a brief review to do justice to the excellence of the account given. The two following errors may be noted with a view to their correction in future editions. On p. 208 the word "perilymph" is used instead of "endolymph." Some confusion has also arisen in the discussion of the theory of hearing suggested by Helmholtz. In consequence, the first two sentences of the final paragraph of p. 229 require to be re-written. Fortunately, since the two sentences are obviously contradictory, there is little risk of the reader being led astray.

The sixth chapter deals fully with the dioptric mechanisms of the eye; while chapter vii. is devoted to the study of the structural features and properties of the retina, and the retinal changes concerned with vision. The description of the electromotive changes occurring in the retina as the result of exposure to light does not include the more recent results obtained by the use of the string galvanometer.

Chapter viii. contains an extremely lucid account of the movements of the eyeballs, of binocular vision, and of visual perceptions and judgments. It closes with the description of the protective and secretory mechanisms of the eyeball.

General metabolism forms the subject-matter of chapter ix. The historical development of the subject is fully discussed. A necessarily brief but clear account is given of the methods employed for the estimation of the intake of foodstuffs and oxygen, and the output of solid and gaseous waste products. Chapter x. is devoted to the discussion of the regulation and measurement of heat production in the organism; while chapter xi. deals with the various theories of nutrition, and the experimental and statistical evidence upon which they are based. Chapters xii. and xiii. are given up to the physiology of reproduction. An excellent survey of the physiology of pregnancy, parturition, and lactation is given in chapter xiv.

The subjects of development, growth, maturity, and senile decay occupy the fifteenth chapter. The two latter subjects receive a much more detailed treatment than is usual in text-books of physiology, and the whole chapter is one of exceptional interest.

The wide view of the scope of physiology held by the author is well illustrated by the final chapter, which is anthropological in nature, dealing with the characteristics of the various races of mankind from the physiological point of view. It has been contributed by Prof. S. Baglioni.

Clearly no pains have been spared to make this text-book adequate for the needs of senior students of physiology, and Prof. Luciani may well be congratulated on the completion of a text-book which may fairly be described as a colossal task for one writer. The work is well and profusely illustrated and clearly printed.

TYPICAL AMMONITES.

Yorkshire Type Ammonites. Parts i–viii. Edited by S. S. Buckman. The original descriptions reprinted, and illustrated by figures of the types, reproduced from photographs mainly by J. W. Tutcher. (London: William Wesley and Son, 1909–1912.) Price 3*s.* 6*d.* net per part, post free.

WITH the issue of the eighth part of Mr. S. S. Buckman's "Yorkshire Type Ammonites" the first volume of this important work is brought to completion. The chief aim of this publication, as pointed out in Nature for February 17, 1910 (p. 455), is to establish on a sound basis, by photographs of type-specimens and by critical and descriptive notes, the species imperfectly made known in the writings of Young and Bird, John Phillips and Martin Simpson. The method followed is akin to that adopted in the well-known "Palæontologia Universalis"; and in undertaking his arduous task Mr. Buckman has been fortunate in securing the collaboration of Mr. J. W. Tutcher, who possesses much experience and skill in carrying out photographic work of this kind.

The present volume happens to deal only with Liassic species, sixty-seven of which are depicted in eighty plates. The fact that no more than a single species appears on any one plate, and that the descriptive letterpress and illustrations relating to each species are issued in the form of a separate unit, will facilitate a rearrangement of the plates in any desired zoological or stratigraphical order. With the final part of the volume, which includes an index, is issued a useful measurement table designed by Mr. Tutcher. This gives a ready means for ascertaining the proportional measurements of a specimen and the amount of its enlargement or reduction in a figure.

There are several features which add greatly to the value of this work. The notes and comments which elucidate the application of certain generic names will be welcomed by many workers in this field of study. A separately paged introduction contains useful and suggestive matter under the headings "Terminology" and "Ammonite Development," where some important theoretical points are concisely handled. Generalisations regarding the cyclical development of shell-form and ornament in the evolution of the ammonite test are illustrated by a series of tables accompanied by explanatory text.

No one engaged in ammonite studies can afford to dispense with this work, which deserves generous support. It is to be hoped that the issue of the succeeding volume may not be long deferred.

TOPOGRAPHY AND TRAVEL.

(1) *From Pole to Pole.* A Book for Young People. By Sven Hedin. Pp. xiv+407+xxxix plates. (London: Macmillan and Co., Ltd., 1912.) Price 7*s.* 6*d.* net.

(2) *Highways and Byways in Somerset.* By E. Hutton. With Illustrations by Nelly Erichsen. Pp. xviii+419+map. (London: Macmillan and Co., Ltd., 1912.) Price 5*s.* net.

(3) *A History of Geographical Discovery in the Seventeenth and Eighteenth Centuries.* By E. Heawood. Pp. xii+475. (Cambridge University Press, 1912.) Price 12*s.* 6*d.* net.

(4) *New Trails in Mexico.* An Account of One Year's Exploration in North-western Sonora, Mexico, and South-western Arizona, 1909–10. By Carl Lumholtz. Pp. xxv+411+plates. (London: T. Fisher Unwin, 1912.) Price 15*s.* net.

(1) DR. SVEN HEDIN'S book, which is for young readers primarily, is conceived on no very formal lines. It is evidently intended to convey, by means of a light descriptive style, a series of impressions or mental pictures of different regions of the world, rather than to instruct in details. Naturally enough, his text is based in great measure on his own travels, and in the first and larger of the two parts into which the book is divided we find a good deal of personal narrative which cannot fail to attract youthful readers; withal it will serve an educational purpose of no little value as giving an idea of the objects and methods of scientific exploration. In this first part we are conducted across Europe from Stockholm to Constantinople, thence into Persia, India, central Asia, China, Japan, and homeward. In the second part, Africa, the Americas, the South Seas, and the polar regions are given more brief, and in truth less satisfactory, treatment, mainly by means of a choice of individual salient features for description, or isolated facts of history. There are some sketch-maps and good photographs.

(2) Readers who know the peculiar charm of Mr. Hutton's writing on English topography will expect much of a volume of the "Highways and Byways" series bearing his name. They will not be disappointed, for his volume on Somerset must be one of the most pleasant in the series to read. Moreover, along with evidence of deep historical research they will find here and there signs that the author possesses the scientific eye for topography, as when he describes the isle and vale of Avalon in their physical relationship, and discusses the former as it may have appeared when an island in fact. Miss Nelly Erichsen's work as an illustrator is no less welcome than familiar, and the choice of subjects seems excellent, each picture justifying its inclusion by its relationship to the text.

(3) The textual standard of the Cambridge Geographical series—which is higher than the mechanical standard of printing and binding—is well maintained in Mr. Heawood's volume. The

seventeenth and eighteenth centuries in the history of exploration have been subject to a certain neglect, not unnaturally, for the century which preceded them was more brilliant than either. Students of Mr. Heawood's volume will probably find the narrative to amend their perspective (so to say), for the stream of geographical exploration flowed so full during the period that there has been some tendency to describe a few of its salient features to the total exclusion of all others. Mr. Heawood corrects this tendency: though he gives due prominence to so commanding a figure (for example) as James Cook, he also shows his work in its proper historical setting, with suitable reference to his half-forgotten predecessors (so far as he had any) and followers in the wide field over which he ranged. The book is readable and convenient for reference, and the author appears also in the *rôle* of cartographer, for several sketch-maps judiciously illustrating the salient features of early maps are by his own hand. The Cambridge series has performed a useful function in presenting certain aspects of geographical study which are not otherwise easily accessible for study in convenient form. A reference to its list will demonstrate this, and for the reason above cited the present volume would have been justifiably included in the series if on that ground only.

(4) Mr. Lumholtz offers in the volume under notice a popular account of his geographical and anthropological researches in an area of which relatively little has been known, lying about, and mainly north-east of, the head of the Gulf of California. His results in this account are introduced mainly as incidental to the narrative of his travels and experiences; we learn that he was primarily concerned to investigate "certain economic possibilities" of the region, but these do not find any important place in the book. With the inhabitants, however, he established a close acquaintance; he is able to offer by illustration and otherwise considerable insight into their life, customs, and languages, and in an appendix he furnishes a short comparative vocabulary of Papago, Pimo, and Colopa Indian words. He also treats (again with illustrations) incidentally of the antiquarian remains, the vegetation, and the fauna of the region, so that the book will, as a whole, be found to furnish a good general idea of it. There is a large-scale map which is quite effective, and, though still necessarily "sketchy," adds something to the cartographical knowledge of the area, since it embodies material not only from previous work, but also from the author's own surveys.

OUR BOOKSHELF.

Scottish National Antarctic Expedition. Report of the Scientific Results of the Voyage of s.y. *Scotia* during the years 1902, 1903, and 1904, under the Leadership of Dr. W. S. Bruce. Vol. vi., Zoology. Parts i.–xi., Invertebrates, by Dr. C. Vaney, Dr. J. Ritchie, Dr. E. L. Trouessart, Dr. W. E. Hoyle, and others. Pp. xi + 353 + plates. (Edinburgh: The Scottish Oceanographical Laboratory; Oliver and Boyd; Glasgow: J. MacLehose and Sons, 1912.) Price 30*s*.

Dr. Bruce is to be congratulated on vol. vi. of the report of the scientific results of his *Scotia* voyage, for it is very valuable in itself and reflects credit on the leader's energy and skill in organising the collecting. The volume is devoted to invertebrates, and it consists of expert reports on very interesting material. It is an important contribution to our knowledge of the antarctic fauna, and it adds some interesting material to zoological data in general. Thus we find Prof. Clément Vaney speaking of "une très importante collection d'Holothuries," Dr. James Ritchie referring to "the enormous mass of [Hydroid] material brought together by Dr. Bruce during his antarctic voyages," Messrs. Melvill and Standen defining in a supplementary collection of marine molluscs more than twenty new species, Mr. J. Wilfrid Jackson reporting that the Brachiopods collected add materially to our knowledge of the geographical range of certain forms, and augment the antarctic list of species; and so it is all along the line.

We may direct attention to Prof. Chilton's fine treatment of the Amphipods, already referred to in Nature, Dr. Thomas Scott's important report on the Entomostraca, and to the short but interesting and scientifically cautious report on the Cestodes by Dr. John Rennie and Mr. Alexander Reid. Equally important, so far as the material went, are the reports on Acarina by Dr. E. L. Trouessart, on the Cephalopods by Dr. W. E. Hoyle, and on microscopic fauna by James Murray and E. Penard.

Le Origini Umane. Ricerche Paleontologiche. By G. Sergi. Pp. xi + 202. (Torino: Fratelli Bocca, 1913.) Price 3.50 lire.

In this useful book Prof. Sergi, of the University of Rome, gives a concise statement of the opinions he holds regarding the origin and evolution of human races. His opinions and inferences demand the most respectful consideration, for they are founded on the investigations of a lifetime, and have in every phase of his busy life been marked by an independent and courageous judgment. Prof. Sergi distinguishes five *genera* of mankind, and regards each of them as of independent origin, their relationship being represented, not as diverging branches from a common trunk, but as parallel or collateral stems issuing separately from an ancestral stock. He also regards anthropoids as parallel developments—

explaining their structural relationships to human races as inheritances from a common basal stock.

It will be thus seen that Prof. Sergi is the arch-priest of that heterodox doctrine—the multiple origin of closely allied species and genera. His faith is more robust than that of the majority of his colleagues. He accepts implicitly Ameghino's speculations concerning the independent origin of mankind in South America. Although the reviewer regards the majority of Prof. Sergi's opinions as ill-founded, he is only too willing to admit that it would be presumptuous, in the present state of our knowledge of extinct forms, to refuse them a most careful investigation.

A. K.

Vicious Circles in Disease. By J. B. Hurry. Second edition. Pp. xiv+280. (London: J. and A. Churchill, 1913.) Price 7*s.* 6*d.* net.

In the issue of Nature for May 18, 1911 (vol. lxxxvi., p. 374), an extended review by Sir T. Clifford Allbutt was published of the first edition of Dr. Hurry's book. The present edition has been revised, and six new chapters have been added in the hope of covering the ground more adequately. Most of the material of these additions has appeared already in the medical Press.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Soil Fertility.

Dr. Russell begs the whole question in two lines of his letter in Nature of January 16, when he terminates para. 7 with "the increased gain in plant growth on such highly heated soils can be largely attributed to this cause," viz. to the formation of ammonium and other simple soluble nitrogen compounds on heating soils to 170°.

If this were true, then the effects of heating soils, whether to the temperature of "partial sterilisation," viz. 98° (as in Dr. Russell's experiments) or (as in mine) to 170°, could be imitated by adding in, say, daily doses, suitable solutions containing ammonium compounds and nitrates.

I have repeatedly tried this with various combinations of salts, both in pot experiments and in the field, and have invariably found that the increased growth due to heating the soil previously was never even approached in extent by that in any of the plots or pots to which the manures were added.

It appears to me that the increased growth in Dr. Russell's experiments can only be safely ascribed to the manufacture of soluble nitrogen compounds by bacteria when in parallel sets of pots and plots the same effect is shown to be produced by artificially dosing unheated soils with such nitrogen compounds.

F. Fletcher.

Rewika Ranch, Kyambu, British East Africa, March 6.

I am not at all surprised that Mr. Fletcher failed to reproduce the conditions of a strongly heated soil by simply adding frequent doses of ammonium compounds to an unheated soil. Soil suffers considerable decomposition when heated to 170° C., and changes markedly in chemical composition, physical properties, suitability as a medium for the growth of bacteria, moulds, and other organisms, and as a habitat for the higher plants. Experiments become extraordinarily difficult to interpret when so many factors change simultaneously, and for this reason I have always preferred to adopt very much milder methods, treating the soil with antiseptic vapours (*e.g.* toluene), or heating to as low a temperature as possible (60° to 95° C.). Here less complication arises, because the decomposition effects are at a minimum, and one can study the various factors one at a time.

Increases in productiveness equal to those brought about by treatment with antiseptic vapours or heating to 65° C. can be obtained on our normal untreated soils by additions of sodium nitrate or ammonium sulphate. Further, partial sterilisation has failed to bring about increased productiveness when the treated and untreated soils are subsequently so liberally treated with nitrogenous plant food that the nitrogen supply is no longer a limiting factor. In "sick" soils, however, there is another limiting factor, the presence of disease organisms and pests, and this also is put out of action more or less completely by partial sterilisation. Here addition of nitrogenous plant food (which leaves the pests unaffected) does not make the untreated soil equal in productiveness to the partially sterilised soils. We could get no evidence of the toxin suggested by Mr. Fletcher, and, this being the case, I do not see how we shall advance matters by assuming its presence as a third limiting factor.

E. J. Russell.

Rothamsted Experimental Station, Harpenden.

Induced Cell-reproduction in the Protozoa.

I was interested in Mr. T. Goodey's letter under the above heading in Nature of March 13, but should like to make a few remarks thereon. Hay infusion, which Mr. Goodey states caused the excystation of *Colpoda cucullus*, is prepared from dried grass, and here we have the products of cytolysis, and, in consequence, should expect the presence of auxetics. As a matter of fact, any vegetable infusion contains auxetics, the presence of which can be demonstrated by the jelly method on human lymphocytes, as described by Dr. H. C. Ross, "Induced Cell Reproduction and Cancer" (London: John Murray, 1910). Encysted forms of Colpoda cannot be compared with the winter spores of Polytoma, as in Colpoda there is, so far as I can gather from Mr. Goodey's letter, no conjugation prior to the encystment, and consequently no real development is necessary for the excystation, but only rupture of the cyst-wall. In Polytoma, however, the cytoplasm within the spores has to undergo several complex changes, leading ultimately to division of sarcode, formation of envelopes round the products of division, and the development of flagella. Thus, I take it that in Colpoda there is no reproductive process in the excystation, and consequently no necessity for auxetics; anything that will cause the rupture of the cyst-wall being sufficient, although, as already shown, auxetics were certainly present in the hay infusion.

With regard to the "pure distilled water," Mr. Goodey should remember that this is pure only so long as he adds nothing else to it. Directly organisms are added, auxetics would be present, as, apart from the fact that some of the culture fluid would be introduced with the organisms, even if this were not so, auxetics would be present, as there would be necessarily some death-rate. The same phenomenon also occurs in pond Amœbæ, the encysted forms of which can also be caused to undergo excystation by incubation with distilled water.

Whether auxetics are necessary for any form of cell-reproduction to occur is a point which will require further research to determine. It is, however, a striking fact that Dr. H. C. Ross was able for the first time to induce divisions in human leucocytes by means of auxetics, and was also able to demonstrate that the ova of *Ascaris megalocephala* will undergo division if incubated with auxetics. Dr. Fansham has also shown that *Entamoeba coli* can be caused to divide through many generations by means of these substances, whilst Dr. E. H. Ross has demonstrated that auxetics have a very remarkable action on trypanosomes.

From the foregoing facts it is clear that auxetics are *a cause* of cell-reproduction, and, although we cannot as yet state positively that there are no other causes, yet, judging from other biological examples, it is extremely probable that they are the sole cause, as it is very unlikely that a complex function like cell-reproduction should have more than one direct cause. With regard to the presence of auxetics and kinetics in pond water, I may say that I am at present investigating this point, and have definite proof of the presence, not only of auxetics, but also of kinetics or augmentors, in such waters, the latter bodies apparently varying according to the season, and also being dependent on the amount of albuminoid ammonia present.

Besides the presence of auxetics in hay infusion, there is one further point to be mentioned, viz. that if by the action of an enzyme, the cyst-wall in Colpoda were dissolved, quite enough auxetic would probably be liberated to cause division, were such necessary for development. This was well shown by Dr. H. C. Ross, who found that substances not themselves auxetics may yet have auxetic action by causing limited cell death immediately within the walls of ova, thus setting free enough auxetic to cause cell-division.

Aubrey H. Drew.

69 Ewhurst Road, Crofton Park, S.E.

Units of Pressure in Vacuum Work.

Referring to the letter by Mr. Shaw in Nature of March 20 (p. 95), I beg leave to remind readers that we have already a convenient unit of pressure which, as fitting in an absolute system of units, is preferable to the micron of mercury, viz. the dyne per cm.^{2}, or the barye of the c.g.s.-system. In fact, Prof. Knudsen has used it in all his later researches on molecular phenomena. In article V10 of the "Encyklopaedie der mathematischen Wissenschaften," p. 628, note 19 (Communications from the Physical Laboratory at Leyden, Suppl. No. 23, p. 14), by Prof. Kamerlingh Onnes and myself, we have given practically the same unit under the name of *millitor* as convenient for such pressures as those in Röntgen vacua.

In doing this we have followed the lead of the commission of the International Association of Refrigeration (*Bull. de l'Ass. internat. du froid.* 2, 1911, p. 38, rapporteur M. Ch. Ed. Guillaume). This commission proposed to accept the metre-kilogramme-second system for general use, this one having better chances than the c.g.s.-system, and accordingly to introduce as an absolute unit of pressure the m.k.s.-unit. As a practically identical realisation of it the commission proposed to introduce the *international centitor* (abbreviated for centi-torricelli), the international kilotor being equal to the pressure of a column of practically 75 cm. of mercury under normal gravity (for further particulars see the article quoted above). Practically 1 millitor = 1 dyne/cm.^{2}, or barye, and within the accuracy of experiments in the domain of these vacua 1 millitor = 0·75 μ of mercury.

Seeing how simple this proportionality factor is, the work of reducing, say, McLeod gauge readings to millitors will not cause any appreciable trouble, whereas the indications by Prof. Knudsen in dynes/cm.^{2} are without any reduction expressed in millitors. For the highest vacua the *microtor* $= 10^{-3}$ millitor $= 0{\cdot}75 \times 10^{-6}$ mm. of mercury would be convenient. As abbreviations, mtor may be written for millitor, μtor for microtor.

W. H. Keesom.

Physical Laboratory, Leyden.

Reflection of X-Rays and X-Ray Fringes.

Accounts of the reflection of X-rays and of X-ray fringes contributed to Nature by Messrs. Bragg, Moseley, Barkla, Hupke, Keene, and others induce me to send you some results that I have obtained recently in the same direction.

I think that the appearances observed by Messrs. Laue, Friedrich, and Knipping are really due to the same cause as the reflected spots; they present quite a similar distribution and general character.

Fig. 1 shows the pattern obtained with a beam of Röntgen rays falling at an incidence of 80° upon a face of a cube of rock-salt, the photographic plate being at right angles to the reflected beam. The reflected spots are similar to the transmitted spots, and present fringes perpendicular to the plane of incidence; they are situated on an elliptic curve, to which belongs also the point of impact of the primary beam. The spot on the main axis is regularly reflected; the others are symmetrically disposed, and possibly due to reflection on the planes of the corresponding octahedron, dodecahedron, &c., which are in suitable positions. Fluorine gives the same pattern.

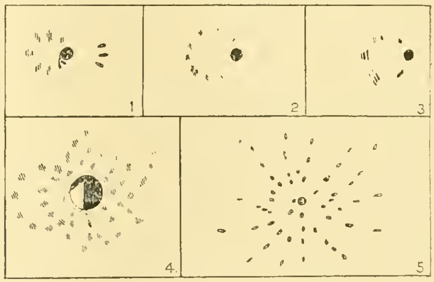

Fig. 2 is obtained with a beam (incidence 80°) falling upon the triangular face of an octahedric crystal of magnetite. The reflected spots show two systems of fringes, one of which is approximately perpendicular to the plane of incidence.

It seems of importance to pay attention to the angle between the intersection of the plane of incidence and the quaternary axis situated in the cubic face of reflection. Fig. 3 shows that when this angle (which was 0 in Fig. 1) becomes 45°, the curve of spots is deflected, the regularly reflected spot being no longer on the main axis but following the ordinary law of reflection; the distance of the fringes is probably slightly changed in this case.

I have often observed fringes in the transmitted spots obtained by Laue's methods. With octahedric magnetite (Fig. 4) all the spots (more than 100) were striated by parallel fringes; and on a plate (Fig. 5) obtained with fluorine the transmitted spots, the number of which was also very large, are all doubled in a radial direction.

I may add that one obtains quite similar phenomena with ordinary light and two ordinary (200 lines per millimetre) gratings, when the incident beam forms similar angles of incidence with the plane of the gratings. M. de Broglie.

Increase of Definition in a Moving Telescope.

I have received several suggestions, for which I wish to express here my indebtedness, as to the probable explanation of the increase of definition in a moving telescope, referred to in my letter in Nature of March 27. They are chiefly based on the principle of "contrast" as described by Mr. G. W. Butler in Nature of April 10, but Mr. W. H. Robinson, of Oxford, attributes the increase of definition to "averted vision," by which a faint source of light is better seen if the eye be directed a little on one side of it. This, at first, seemed to me the correct explanation, the more satisfactory that it involves but a well-known physiological property of the eye. By moving the telescope the object is continually eluding the eye, and visibility by continuous unconscious "averted vision" would be the result. I, however, satisfied myself that there must be some other cause, as a *deliberate* use of "averted vision" failed entirely to show me the time-ball when I tried it after receiving Mr. Robinson's letter, while I noticed that, as soon as the sweeping motion had begun, it was plainly visible by *direct vision*, my eye following it all the time. Mr. Butler's suggestion seems therefore more plausible, although less definite.

M. E. J. Gheury.

Woolwich Polytechnic, April 15.

THE NINTH INTERNATIONAL CONGRESS OF ZOOLOGY AT MONACO.

The ninth International Congress of Zoology terminated its session under the presidency of his Serene Highness the Prince of Monaco at Monaco on Saturday, March 29. Altogether, the meeting was an unqualified success, not only on account of its numbers, which, as already stated, were greater than on any previous occasion, but also for the general interest of the contributions, which, although no single one can be selected as absolutely outstanding, were all of very high quality, and demonstrated the result of much serious and useful work by zoologists during the past three years. The beauties of the Côte d'Azur doubtlessly attracted many from northern lands, and although the weather was not all that could be expected for the Riviera at this season, yet the rather copious rainfall settled and washed away the dust and refreshed the herbage, which was the more brilliant during the intermittent periods of bright sunshine. The chief attraction, however, was the noble Oceanographical Museum, which crowns the cliffs of the rock upon which the town of Monaco with its palace is situated, and the fact that the congress was to hold its chief meetings within its precincts, with its founder as their president.

The opening reception in the museum, the holding of many of the meetings of the congress within its walls or only across the other side of the road at the Lyceum, and the fact that members were entitled to visit all its galleries and its aquarium at any time during the whole congress enabled everybody to become thoroughly acquainted with the museum and its interesting collections. Since its opening in 1910 there have been great developments and additions, thanks to the indefatigable energy of Dr. Jules Richard, its able director, and his assistants. A very full account of the museum was given soon after its opening in the columns of Nature by Mr. J. Y. Buchanan; it is not, therefore, necessary to repeat what he has said, but since that time there have been many developments, and among others the opening up of a large new gallery in the western wing of the building. Zoologists were especially delighted, not only in seeing the excellent cetacean collection—whales mostly captured by the Prince himself—but also the really marvellous collection of well-mounted deep-sea fishes, which were familiar to many as figures, but the original specimens of which they now saw for the first time, and the same may be said of the invertebrates. A particularly useful and instructive arrangement is that side by side of each specimen is placed, where possible, the original painting of the animal taken from the fresh specimen, or the reproduction of such a coloured drawing as presented in the unique plates appearing in the Prince's publications. This is specially valuable, since it is impossible to preserve the original colours of animals in alcohol and because a better idea of the form of the fresh animal is given.

Besides the Prince's collections were also shown the first fruits of exchange with outside collections, and notable among these was a case containing many of the deep-sea and shallow animals taken by the *Scotia*. There is also a well-mounted case of penguins taken by the French Antarctic Expedition, as well as seals, birds, and eggs taken by the *Scotia* in the antarctic regions.

The collection of instruments and various forms of fishing appliances, nets, trawls, dredges, traps, hooks, &c., used not only for scientific but also for economic fishing, was also a source of attraction, and not least of all the aquarium with its wonderful living forms of Mediterranean fishes and invertebrates, each more wonderful than its neighbour, and which only those who had previously visited such stations as Villefranche and Naples had seen before, but were more than ready to see again.

Some days before the opening of the congress many zoologists made their appearance, and on Monday, March 24, practically the complete roll of 723 members, including more than eighty British representatives, was signed, and members had received their insignia, cards, and papers. On Tuesday afternoon there was a meeting of the permanent committee for the election of vice-presidents of the congress and presidents of the sections, Lord Walsingham being chosen first vice-president. At 6 p.m. the congress was formally opened by the Prince, who, dressed in the official uniform of the Institut de France, delivered his inaugural address. The president was supported by the delegates of twenty-four Governments, the only Government not being officially represented being the British Government; very appropriately, however, the Prince recognised Lord Walsingham, one of the trustees of the British Museum, as the official representative of Britain.

In an eloquent address the Prince suggested that by their meeting at Monaco, zoologists marked the importance of the study of marine animals, that they conceived that marine zoology possessed the principal elements necessary to elucidate the history of life and the origin and evolution of its different forms. They had considered this temple of oceanography worthy of an assembly which dealt with these subjects. These congresses, he said, should be encouraged because they brought about a *rapprochement* of men of all shades of opinion from countries representing occupations of intelligence. They measured the force of production of different human communities, and gave young people an opportunity of associating rapidly with the general progress of ideas. The study of zoology was of the greatest significance, because it dwelt upon the history of life, effacing illusions of ignorance. Above all, the study of marine zoology was precious in relation to the investigations of the origin of life. He believed that the ocean was the origin of life, and that there was ancestral colonisation from the waters to the land. The Prince emphasised that, in the study of oceanography, it was important to investigate the regions that lay above the surface of oceans; hence his investigations of the higher atmosphere. Finally, he asked the congressionists before leaving the old rock of Monaco, still scarred by old buildings which marked the law of force, to consider well the edifice constructed to arbitrate in favour of science. Below was the savage instinct which was now surmounted by progress, time giving dominion to creative force over the vain rivalries of man. He emphasised how these developments had taken place in a country long protected by peace.

The Prince was followed by Dr. Perrier, director of the Natural History Museum of Paris, the eminent president of the permanent commission of the congress. Dr. Perrier dwelt on the importance of oceanographical research to zoology, paid well-merited eulogy to the Prince for his great and lifelong services to oceanography and zoology, and also to the epoch-making work of Guyon, Jeffreys, Wyville Thomson, and William Carpenter. In the evening there was a reception given by the president in the museum, which gave the first opportunity of congressionists meeting each other and discussing various matters of common interest—a feature, indeed, which is perhaps, after all, the great result of all such meetings, for one hears of some fellow man of science and one knows something of his work, reading much perhaps that he has published and probably having also corresponded with him, but now for the first time one meets him face to face, discusses knotty points to the immense advantage of each, often clearing away misunderstandings and sealing a bond of friendship. This was especially the case at Monaco regarding the long discussion on nomenclature.

More than 150 papers were given by different authors, and most of these were given in abstract, in many cases being illustrated by lantern or kinematograph. Time, however, curtailed many authors, and compelled others to have their contributions held as read. British zoologists were on this account deprived of hearing Prof. Ewart give an account of the new zoological gardens to be opened in July in Edinburgh by the Zoological Society of Scotland, which promises to be one of the finest, if not the finest, zoological garden in Europe.

Among British contributions was one by Prof. Elliot Smith, of Manchester, who gave an account of the homologies of the cerebral cortex in vertebrates. Prof. J. Arthur Thomson, of Aberdeen, gave an important communication on Alcyonarians recently collected by H.S.H. Prince Albert I. of Monaco, illustrating his remarks by a series of finely executed paintings which are to form the plates of his monograph. Mr. G. P. Mudge, of the London Hospital Medical College, gave an interesting communication on some problems of hybridisation, whilst Dr. Scharff, of Dublin, gave a paper on zoogeography, giving an account of his most recent researches in a subject to which he has devoted so much attention with such excellent results. Prof. Hull, late director of the Geological Survey of Ireland, discussed recent discoveries in the physical features of the North Atlantic Ocean, as confirming the view of the distribution of European animals by land connection in Tertiary times.

Dr. W. S. Bruce, of Edinburgh, summarised the zoological results of the *Scotia*. He pointed out that the leading feature of the *Scotia's* work was her investigations in great depths in high southern latitudes by means of trawl and vertical plankton net. The percentage of new species taken in great depths down to 2645 fathoms was very high. Out of about a thousand *Scotia* species described more than 25 per cent. were new to science. The zoological researches of the Scottish naturalists disproved bipolarity, those species which had a bipolar distribution having also universal distribution. They tended also to show that antarctic fauna was not circumpolar, at least to the extent that arctic fauna was, but that it was subdivided into regions, which appeared to be associated with the south polar "deeps" separated by those "rises" which probably indicate former connections of Antarctica with the more northern continental land masses.

The Indian Museum, Calcutta, accounted for a goodly number of interesting communications. Dr. Nelson Annandale gave an important paper on the African element in the fresh-water fauna of India. He showed there was a strong affinity, extending even to species in some cases, between fresh-water sponges, Hydrozoa (Limnocnida), and Polyzoa of India and of tropical Africa. In some instances this affinity extended to South America. The same phenomenon existed in other groups, and indicated former land connection. So far as the invertebrates were concerned, there was little evidence of any African element in the aquatic fauna of the Jordan valley, although many African fishes are found in that district. The difference between the African element in the fresh-water fauna of India and that in the fresh-water fauna of Palestine is probably due to the fact that the geographical connection was broken at a comparatively early date in the case of India, and that the climate and the composition of the water of the Jordan at present differ greatly from those both of India and Africa. Captain R. B. Seymour Sewell, I.M.S., surgeon-naturalist to the Indian Marine Survey, gave a communication on the post-larval development of the Copepoda. The collections on which these observations were based were from three estuarine regions on the coast of Burma and Bengal. In their post-larval development the Copepoda follow Brooks's law, and under suitable conditions apparently may be dimorphic in both sexes, thus resembling Amphipoda and Ostracoda.

Prof. Roule, of Paris, described a new species of abyssal fish, to which very great interest is attached, because it was captured by the Prince of Monaco in the great depth of 6035 metres, a depth in which no fish had previously been caught. Prof. V. Dahlgren, of Princeton, gave an account of his recent researches in a remarkable polarity in the motor nerve cells of the electrical apparatus of *Tetronarce occidentalis*. Prof. Th. Mortensen, of Copenhagen, described a new genus and species of a sessile Ctenophore, upon which Prof. Ziegler, of Stuttgart, made some important comments. Miss Foot and Miss Strobell, of New York, showed the results of crossing three Hemiptera species with reference to the inheritance of an exclusively male character. Prof. J. Petersen, of Copenhagen, gave a paper entitled "Determination of the Quantities of Animal Life in the Sea: its Communities and their Geographical Value." Prof. C. Wardell Stiles, of Washington, gave an account of the distribution of *Nector americanus* in the United States, its medical and economic importance, and the campaign for its eradication. This formed one of a series of important papers on applied zoology.

Dr. Jacques Liouville, of Paris, emphasised the importance of constructing a faunistic chart of the artarctic regions, especially in relation to the continental shelf. His suggestion was specially supported by Prof. J. Arthur Thomson, who thought Dr. Liouville should be thanked for taking the initiative in this matter. Mr. Heron-Allen and Dr. Bruce also supported the suggestion. Dr. Liouville suggested taking up the French section, and Dr. Bruce agreed to take the Scottish section, suggesting that others should similarly be asked to join, and further that the president of the congress should be asked for his patronage, and also be requested to allow the publication of the chart to appear in his publications. This was afterwards further approved of in the general section.

M. Henri Bourée gave two kinematograph and colour photograph lantern demonstrations, illustrating the work of the Prince and his staff on board the *Princesse Alice*. The series of pictures is excellent in every respect, the colour pictures of animals being exquisite, and the kinematograph pictures showing sounding, trawling, fishing, and whaling operations being most instructive.

The subject of zoological nomenclature played a large part in the proceedings. It had been feared that there might be a battle royal between the advocates and opponents of the law of priority, carried out to the bitter end, but happily preliminary discussions of a more or less informal kind led to the adoption of a *via media*. A resolution was adopted which empowered the nomenclature commission to suspend the rules in cases where it would cause great confusion to carry them out. This power is, however, safeguarded by such stringent conditions that there is no fear of its being used except in very urgent cases. Prof. Brauer opened the discussion on nomenclature, presenting the well-known views of the German Zoological Society, and was followed by the Hon. Walter Rothschild and Dr. Hartert, of Tring, M. Oberthur, of Rennes, Prof. E. Ziegler, of Stuttgart, Prof. S. W. Williston, of Chicago, Prof. Fauvel, of Angers, Prof. Th. Mortensen, of Copenhagen, Lord Walsingham, of the British Museum, Dr. Hoyle, of Cardiff, Dr. J. A. Allen, of New York, and Dr. Ch. Wardell Stiles, of Washington, the secretary of the permanent committee.

In proposing a resolution "That an international commission on entomological nomenclature be appointed, whose powers and authority shall be equal to those of the existing commission on zoological nomenclature, and who shall report their decisions and recommendations annually to the Zoological Congress," Lord Walsingham emphasised that the principal object of zoological nomenclature was to give to all zoologists the means of acquiring and imparting information about the subjects of their studies. The aim should be to establish an accepted system ensuring simplicity and finality in nomenclature. This had to be attained on the basis of the law of priority. He supported Dr. Ernst Hartert against certain proposals put forward by the German Zoological Society which, if adopted, would be fatal to any attempt to obtain uniformity or finality in nomenclature. The first principles of the law of priority must be adhered to. Let revision be gradual, and proceed on well-considered lines, subject to the final authority of the International Zoological Congress, acting on the recommendations of its two equal commissions—that of general zoology and that of entomology.

The Hon. Walter Rothschild emphasised the point that any society or individual proposing such an important change as that proposed by the German Zoological Society ought, if they wanted serious consideration at all, to put their meaning in absolutely clear and unequivocal language. He stated that the time quoted, "twelve" years, as being sufficient to judge of the need of the "law of priority" was absurd, as it would take at least two generations for the law in question to settle nomenclature in general, and at least one generation before we could judge of its effects. Mr. Rothschild also stated that a progressive list of exceptions to that law, namely, one to be augmented from congress to congress, would lead to utter chaos. He was opposed to any exceptions whatever, but would be willing to see, in cases where confusion was likely to arise, that names for a long time employed for one genus or species, and which under the rules must be transferred to another, should be dropped altogether, and that names differing only in one letter from any already in use should be treated as inadmissible. He was also in favour of using larval names, and those founded on a single phase only, being used in that sense only, and not under the law of priority used for the adult in another phase.

Finally, it was resolved—that plenary power is herewith conferred upon the international commission in zoological nomenclature acting for this congress to suspend the *règles* as applied to any given case, where in its judgment the strict application of the *règles* will clearly result in greater confusion than uniformity, *provided*, however, that not less than one year's notice shall be given in any two or more of the following publications, namely, *Bulletin de la Société Zoologique de France*, *Monitor Zoologica*, Nature, *Science* (N.Y.), and *Zoologischer Anzeiger*; that a question of the possible suspension of the *règle* as applied to such cases is under consideration, thereby making it possible for zoologists, particularly specialists in the group in question, to present arguments for and against the suspension under consideration; and *provided* also that the veto of the commission is unanimously in favour of suspension if not less than two-thirds be present. The commission is hereby instructed to report the facts to the next succeeding international congress.—It was also resolved "That the congress fully approves of the plan that has been inaugurated by the commission of conferring with special committees from the special groups involved in any given case, and that it authorises and instructs the commission to continue and extend their policy." Altogether, the conclusions arrived at appear thoroughly satisfactory, especially as the plenary power of the commission is very adequately safeguarded.

The invitation of the Government of Hungary to hold the congress of 1916 in Budapest was accepted, and Prof. Hovarth, of Budapest, was elected president.

THE INTERNATIONAL CONGRESS OF HISTORICAL STUDIES.

The members of the International Congress of Historical Studies have been holding their meetings in London, under the presidency of Mr. James Bryce, who was, however, unfortunately absent throughout the proceedings. Five years ago, the congress held very successful meetings in Berlin, and ten years ago it assembled under favourable auspices in Rome. If the London meeting has attracted less notice in the country of its assembling than the two preceding ones, it has none the less produced some excellent papers, and it must be accounted a real loss to the general public that the very faulty organisation of the congress, combined with our insular aloofness and the ignorance of modern languages which is an accepted item of English education, has prevented the meetings from receiving their due share of attention.

The congress has covered so large a field of historical studies that any general survey of its deliberations would be impossible in this place. It has discussed the philosophy of history and the history of historical studies, while other sections have met daily to exchange views on Egyptian, classical, Byzantine, and Oriental history, as well as on matters pertaining to military, naval and colonial, religious and ecclesiastical, legal and economic, mathematical and scientific, studies.

The President of the Board of Education (Mr. J. Pease) directed attention to the frequent connection that has existed in England between history and politics, citing the names of Clarendon, Gibbon, and Macaulay, and, at the present time, of Bryce and Trevelyan. The advantages of such a connection may perhaps be questioned. From it has resulted the habit of treating history as a branch of politics rather than of considering politics as a department of history. The current text-book treatment of the English civil war and the American revolution—to give but two instances—has probably suffered much in its accuracy from the fact that the principal English historians have been primarily Whig politicians. To the popular conception of the politician as the sufficient and efficient historian, we may perhaps attribute the neglect by successive Governments of the marvellous series of records—the admiration and envy of other European nations, and the best material for history—which belong to this nation. No one knows better than Prof. C. H. Firth, who dealt with the subject of English records, how badly kept, how inaccessible, how uncalendared, are a great proportion of our English public documents.

It was entirely characteristic of the English politician-historian that, at the Oxford dinner, Lord Morley of Blackburn should warn his hearers against laying too much stress on research in diplomatic archives and parish registers, and should remind his audience that, fortunately or unfortunately, sentiment and prejudice have had far more to do with the making of history than reason and precedent.

The president's address, read in his absence by Dr. A. W. Ward, of Peterhouse, contained references to the importance of recent discoveries regarding the early Mediterranean civilisations, and laid stress on the value of modern critical ethnology for the correct understanding of the foundations of present-day movements in Europe; while Mr. D. G. Hogarth's paper on Hittites and the Hittite civilisation showed that a beginning has been made in attacking an outstanding problem bearing on the same subject. Prof. E. Bernheim spoke of history as a record of the variation of intellectual viewpoint at different epochs of time. Prof. von Gierke dealt with the evolution of the idea of the right of a numerical majority to control the government of a country. Prof. Pirenne gave a suggestive account of the stages in the growth of capitalism from the twelfth to the nineteenth centuries, and described the change from mere subsistence industry and husbandry to the creation of capitalism as an engine by which the advancing intelligence can obtain an increase in knowledge, in material resources, and in control over the forces of nature.

In the subsection devoted to the exact sciences, natural history, and medicine, papers were read by Sir Clifford Allbutt on Palissy, Bacon and the revival of natural science; by Prof. Loria on mathematics in Great Britain; by Prof. Silvanus Thompson on the history of the compass card; by Prof. H. H. Turner on Aristarchus of Samos, and by Mr. Rouse Ball on Newton's Principia and also on magic; Dr. Norman Moore gave an account of the Royal College of Physicians, Prof. L. C. Miall illustrated seventeenth-century research by the life of Peiresc, and Mr. W. C. D. Whetham read a paper on the historical method in natural science.

PUBLIC VETERINARY SERVICES.

A DEPARTMENTAL Committee on the Public Veterinary Services was appointed last August by Mr. Runciman to inquire into the requirements of the public services with regard to the employment of officers possessing veterinary qualifications, and to consider whether any further measures can with advantage be adopted for the selection and training of students with a view to such employment. The committee, the report of which has recently been published (Cd. 6575), consisted of Sir A. Hopkinson (chairman), Sir T. H. Elliott, Sir T. W. Holderness, Mr. H. J. Read, and Major G. F. MacMunn. In October Sir T. W. Holderness resigned, and Mr. F. C. Drake succeeded him.

In all twenty-one witnesses were examined, together with a number of written statements of representatives of self-governing Dominions and universities who for various reasons were unable to attend in person. Evidence was given on behalf of the Departments employing veterinary officers, viz., the Colonial Office, India Office, War Office, and the Board of Agriculture and Fisheries; also on behalf of the five veterinary colleges, the examining and diploma-granting body (the Royal College of Veterinary Surgeons), and various British universities.

After considering the present system of veterinary education, the committee is of opinion that the standard appears sufficient for the purposes of private practice, but not for the public services, for research and administrative work. The army veterinary department has no difficulty in finding suitable candidates, and, moreover, the first two years of the young officer's service are devoted to the improvement of his education, and to training him for his future work.

The demand for the other public services of veterinary officers has increased, and will almost certainly increase still further. Already great difficulty has been encountered in procuring suitably trained men for the posts, alike at home, in the Colonies, and in India. The most important steps to be taken to improve the quality and quantity of candidates are (1) to encourage a larger number of young men who have continued their general and scientific education beyond secondary-school age to enter the veterinary profession; (2) to provide for men who have qualified as veterinary surgeons increased facilities to extend their knowledge, more especially in the direction of specialisation in one branch of veterinary science; and (3) to improve the system of notifying vacancies.

With these objects in view the committee recommends that: Students possessing a suitable science degree should be exempted from one of the four years at present required for veterinary qualifications; that twelve scholarships should be offered each year of the annual value of 80*l.* each, tenable at a veterinary college for three years, with a view to encourage a number of men who have received a good scientific education to enter the veterinary profession; scholarships of an annual value of not less than 100*l.* and not exceeding 150*l.* should be offered each year to enable qualified veterinary surgeons to undertake advanced study and laboratory work at suitable institutions at home or abroad, where special facilities for such studies exist. The committee further recommends that increased State aid should be given to institutions devoted to veterinary education, the efficiency of which is of great importance to the State. It is of opinion that the Royal College of Veterinary Surgeons "is performing a work of great national importance, and that its efforts to maintain a high standard of veterinary education in this country are worthy of every encouragement."

NOTES.

THE International Congress of Zoology at Monaco and that of Geography at Rome are over, but another interesting meeting of representatives of the nations took place on April 5, at the Zoological Station, Naples. The occasion was the unveiling of a memorial tablet to the illustrious founder of the station, Prof. Anton Dohrn. The tablet, in bronze, which has been fixed above the fountain on the north side of the central court between the two great laboratories, was unveiled by Prof. von Graff, who spoke on behalf of the International Zoological Congress, at the meeting of which at Graz it was decided to erect and place within the station a monument to the late Anton Dohrn. Von Graff, in his appreciation of Dohrn's work, referred more especially to the international character which the station has developed under the distinguished direction of its founder. The tablet having been unveiled, Prof. Todaro, of Rome, an old personal friend of Dohrn's, spoke on behalf of the Accademia dei Lincei and the Italian Department of Public Education. Dr. Wever, Consul-General for Germany in Naples, made a speech representing the Foreign Office and the Department of Public Education in Berlin. Marchese del Carretto, Mayor of Naples, spoke of the advantages enjoyed by the town from the aquarium and marine station, and Admiral Raggio Ducarne referred to the connection between the Italian Navy and the zoological station. Wreaths were placed at the base of the monument by the speakers mentioned, and by many of the delegates. After a speech by Prof. Reinhard Dohrn, son of the late Anton Dohrn, and now director of the station, the ceremony concluded.

We regret to see the announcement of the death, on April 14, of Herr Karl Hagenbeck, the owner of the famous zoological park at Stellingen.

The death is announced, at forty-eight years of age, of Mr. Percival Spencer, the well-known balloon manufacturer and aëronaut, who made many notable journeys by balloon, and was closely associated with developments of aërial navigation.

At the annual general meeting of the Selborne Society, to be held in the theatre of the Civil Service Commission, Burlington Gardens, W., on Monday next, April 21, there will be an exhibition by Mr. John Glen of the portrait recently discovered which claims to be that of Gilbert White.

The death is announced of Prof. V. Dwelshauvers-Dery, correspondant of the Paris Academy of Sciences, in the section of mechanics, and of M. Louis Henry, correspondant in the section of chemistry. Prof. Dwelshauvers-Dery was born at Dinant in 1836, and studied engineering at Brussels and Liège, obtaining his degree as doctor of physical sciences at the latter place in 1861, where he afterwards took charge of the course of applied mechanics, and established a laboratory. He gave particular attention to the study of steam engines.

Sir Edward T. Candy, formerly judge of the Bombay High Court, whose death at Great Shelford, near Cambridge, on April 13, in his sixty-eighth year, is announced, took an active share in the work of the Bombay University, and was Vice-Chancellor for five years (1897–1902). He was chairman of the provisional committee of the Indian Research Institute now established at Bangalore through the munificence of the late Mr. J. N. Tata. On his retirement in 1903 he settled at Great Shelford, and he took a keen interest in the affairs of Cambridge University.

A pioneer in telegraph engineering has been lost by the death, at the age of eighty-two, of Mr. E. B. Bright, on April 14. From an obituary notice in the Engineering Supplement of *The Times* we learn that with his young brother, afterwards Sir Charles Bright, he joined the Electric Telegraph Company in 1847. Within a year of entering this new field both became inventors. Perhaps the most important of their early inventions was the system, devised in February, 1849, of testing insulated conductors to localise faults from a distant point, by means of a series of standard resistance coils of different values, brought into circuit successively by turning a connecting handle. In 1851 Charles left the Electric Company, and shortly afterwards became engineer to the British Telegraph Company, while Edward joined the Magnetic Telegraph Company, of which, in 1852, when only twenty-one years old, he became manager. The brothers soon found it necessary to devise fresh apparatus to compensate for the inductive discharge resulting from the long underground circuits by discharging to earth and thus neutralising the recoil currents. From that time until the spring of 1854 they carried out a series of experiments on the great lengths of subterranean wires under their control in order to investigate this novel phenomenon. Edward Bright was largely responsible for the establishment of telegraphic communication between the West Indian Islands by some 5000 miles of submarine cable. He was a member of the Institution of Civil Engineers and a member of council of the Institution of Electrical Engineers.

The Royal College of Surgeons has awarded the triennial prize, with which is given the John Hunter medal, to Dr. W. Blair Bell, of Liverpool, for his dissertation on the anatomy and physiology of the pituitary body. The subject of the prize for the next period is "The Human and Comparative Anatomy and Physiology of the Cerebellum." The Jacksonian prize for the year 1912 has been awarded to Mr. F. W. Goyder, of Bradford, Yorks, for his dissertation on the embryology and treatment of cleft palate. The subject of the prize for the year 1914 is "The Pathology, Diagnosis, and Treatment of Trigeminal Neuralgia."

A joint session of the Aristotelian Society, the British Psychological Society, and the Mind Association will be held in London on June 7 and 8. In the afternoon of June 7 there will be a symposium, "Are Intensity Differences of Sensation Quantitative?" to which Messrs. C. S. Myers, Dawes Hicks, H. J. Watt, and Wm. Brown will contribute. In the evening there will be a discussion of a paper by Dr. Arthur Robinson on memory. The subject of a symposium on June 8 will be, "Can There be Anything Obscure or Implicit in a Mental State?" and Messrs. Henry Barker, G. F. Stout, and R. F. A. Hoernle will take part.

Whatever may be the subsequent effect, if any, of the removal of the Royal Geographical Society from its old centrally situated premises in Savile Row to the "West End," there can be no question as to the enhanced convenience and amenities afforded by the new home at Kensington Gore, which the Society opened on Monday last, after an enforced sojourn in temporary quarters at Cromwell Gardens since the beginning of the year. The house, formerly known as Lowther Lodge, has proved excellently adaptable to its new purpose. The ground floor provides a museum and lounge, in addition to two map-rooms and a council-room—a change indeed from the conditions at Savile Row. The accommodation on the first floor serves for the library, for various rooms for the convenience of fellows, and for offices; on the second floor is the surveying school, with students' and draughtsmen's rooms, while the roof provides space for an observatory for the purposes of the school. The intention is to dispose of a considerable portion of the land attached to the house, but sufficient will be retained to form a pleasant open space on the south side of the building.

THREE evening lectures (the Chadwick Public Lectures, 1913) on the evolution of epidemics are being given by Dr. J. T. C. Nash, at the Royal Society of Medicine, 1 Wimpole Street, W. In his first lecture Dr. Nash pointed out that, although measles is so constantly with us, and smallpox is generally so distinctive, and is yet common enough in various parts of the world, no causal germ has yet been definitely recognised for either disease. Certain other specific diseases have been found to be due to the life-processes within the blood and tissues of higher forms of life than mere bacteria. Malaria is an example of such. In pre-vaccination days smallpox in Great Britain showed a periodic intensity of prevalence every three, four, or five years, but during the latter half of the nineteenth century, since vaccination was made compulsory in 1851, only one widespread epidemic occurred, in 1871–72, when smallpox overran Europe and America; but it must be remembered that vaccination was not the only measure in force, and compulsory notification, disinfection, isolation, "following up" of contacts throughout the incubation of the disease, all assisted in limiting the spread of infection and widening out the inter-epidemic periods. In commenting upon the second Chadwick Lecture, delivered on Monday last, Sir Richard Douglas Powell, who presided, said that Dr. Nash's arguments were of great importance in leading to a salutary speculation on the true character and possible removability of endemic, as well as epidemic diseases. May it not be that the bovine, avian, and human forms of tubercular diseases are distinct only from the fact that for many generations the micro-organisms have been cultivated in the special environments of beasts, birds, and mankind, and that the root-ancestor of all was a fungus dwelling in the earth and ever ready to spread into animal soil? Dr. Nash's lectures should do much to lead students of the etiology of tuberculosis to look back into long-forgotten factors, such as that of soil, which were discussed by Buchanan and other men of medicine in his (Sir Douglas Powell's) early years. The next lecture will be given on Monday next, April 21, when Sir William J. Collins will preside.

IN June Dr. F. W. Mott, F.R.S., will give a course of Chadwick Public Lectures at the Royal Society of Arts, under the title of "Nature and Nurture in Mental Development." Among the lectures in contemplation for the provincial cities are those on the public milk supply—some criticisms and suggestions from the public health point of view, by Prof. Henry R. Kenwood, at Cardiff; on water supply, with exhaustive consideration of sources, collecting works, conveyance, and distribution, by Mr. E. P. Hill, at Birmingham; and on infant welfare, by Prof. Karl Pearson, F.R.S., at the School of Economics, May 16, 23, and 30. Glasgow, Bristol, and other cities of the kingdom will also be provided with Chadwick Public Lectures during the year. All the lectures will be free and open to the public, but will be of a character to attract post-graduate and advanced students of engineering, medicine, and other cognate sciences. The secretary to the trust, to whom all communications should be addressed, is Mrs. Aubrey Richardson, 8 Dartmouth Street, Westminster.

THE Eugenics Record Office, which was established at Cold Spring Harbor, Long Island, in October, 1910, by Mrs. E. H. Harriman, with the additional assistance of Mr. John D. Rockefeller and others, has recently entered upon a new stage of its development. A board of scientific directors has been organised, comprising Dr. Alexander Graham Bell, chairman; Dr. William H. Welch, professor of pathology, Johns Hopkins Hospital, vice-chairman; Prof. Irving Fisher, Yale University; Prof. Lewellys Barker, of Johns Hopkins Hospital; Prof. E. E. Southard, of Harvard University, and director of the Psychopathic Hospital, Boston; and Dr. C. B. Davenport, secretary of the board and resident director. The board met at Cold Spring Harbor on March 21, and organised its work. The aim of the Eugenics Record Office was defined to be as follows:—(1) To promote researches in eugenics that shall be of utility to the human race. This part of the programme includes the study of America's most effective blood lines and the methods of securing the preponderance and relative increase of the best strains; the study of the origin of and the best methods of restricting the strains that produce the defective and delinquent classes of the community; the study of the method of inheritance of particular traits; the study of the consequences of the marriages of close kin; the study of miscegenation in the United States; the study, both in that country and abroad, of the family histories of permanent immigrants. (2) To publish the results of these researches. (3) To provide a fireproof building for the preservation of eugenical records, including genealogical works and town histories. (4) To provide an administrative office and staff to carry out the work.

IN the third part of his useful periodical, *Visvakarma*, Mr. Ananda K. Coomaraswamy gives a further selection of examples of Indian sculpture. The present instalment is devoted to specimens from Java, Cambodia, and Ceylon, all of which betray Hindu influence, while two fine examples from Sarnáth, near Benares, and from Nepal are excellent illustrations of the local art. The photographs are now more artistically reproduced than in the first number of the series, and the collection will be of interest to artists and students of the religions of the East.

We recently deplored the lack of encouragement and support received by the Royal Anthopological Institute of Great Britain and Ireland from the State and the public of this country. When we turn to America the case is very different. From the forty-sixth report of the Peabody Museum of American Archæology and Ethnology, connected with the Harvard University, we learn that steps are being taken to complete the museum buildings according to the original plans prepared fifty-three years ago by Louis Agassiz. The plans provide for the addition of five exhibition halls, each 100 by 60 ft., a stack-room for the library, several workrooms and offices, a photographic room, a lift, and other conveniences. These important extensions are needed to supply accommodation for the vast collections of material which are being collected by parties of explorers at work in all parts of the country, under the guidance of the museum authorities, and the large donations presented to the institution by members of the public.

In *Man* for April Mr. T. C. Hodson discusses the question of seasonal marriages in India. During last February the Kadva Kanbis of Gujarat celebrated, after an interval of some ten years, the weddings of all the marriageable youths and girls in the tribe. A similar custom prevails among a group of the Madras Chettis, and among some Karens in Burma it is only when an official visits their country and orders a wedding to take place that the ceremony is performed. This custom may be an extension of the human pairing season which has been discussed by Prof. Westermarck. At present, among the Kanbis, it seems to be the result of a system of hypergamy—the desire to marry a girl in a grade higher than her own—which results in a scarcity of bridegrooms and increase of the bridegroom price. But it may have originated in some belief connected with astrology, or some tribal custom the cause of which is now obscure.

The Journal of Genetics for February (vol. ii., No. 4) contains three papers, two of which are more of the nature of general reviews and discussions than records of original observation. Dr. A. H. Trow discusses "Forms of Reduplication"—the phenomena more generally known as gametic coupling and repulsion. He points out that if there are factors A, B, C, in which there is coupling between A and B and between A and C, then there will of necessity be secondary coupling between B and C. He works out formulæ for the "secondary reduplication" and compares them with actual cases already recorded. Mr. Clifford Dobell reviews the present knowledge of mutation in bacteria, devoting the greater part of his paper to physiological mutations, *i.e.* inherited changes in the power of producing ferments or pigments. He shows that such mutations have been frequently described, that many of them are apparently spontaneous, but that in some cases at least they are due to change of environment, and that in this case they are not rarely adaptive. Mr. K. Toyama gives a detailed account of the inheritance of egg-characters in the silkworm (*Bombyx mori*). There are a number of definite characters (shape, colour, &c.) in various breeds, and his most important result is that the majority of these characters, even when they depend upon the embryo and not upon the shell, are determined by the constitution of the female parent, and not by that of the embryo. For example, a female of a breed having eggs with the recessive character, mated with a male of a breed having eggs with the dominant character, produces eggs of the recessive character, but the females reared from these eggs, however mated, lay eggs with the dominant character.

"Dominancy in Nature" is the title of the presidential address (of which we have been favoured with a copy) delivered by Mr. J. W. Taylor at the annual meeting of the Yorkshire Naturalists' Union, held on December 14, 1912. The author holds the view that western and central Europe was the birthplace, or dispersal centre, of nearly all groups of animals.

In an account of the manner in which bees collect pollen, published as Bulletin No. 121 of the Entomological Bureau of the U.S. Department of Agriculture, the author, Dr. D. B. Casteel, states that the articles published by Mr. F. W. L. Sladen in 1911, 1912 (one of which appeared in our own columns, February 29, 1912, p. 586), afforded the first true explanation of the function, and that his own observations have confirmed the accuracy of Mr. Sladen's work. "Pollen," he writes, "may be collected by the worker upon its mouth-parts, upon the brushes of its legs, and upon the hairy surface of its body. When the bee collects from small flowers, or when the supply is not abundant, the mouth-parts are chiefly instrumental in obtaining the pollen. The specialised leg-brushes of the worker are used to assemble the pollen, collecting it from the body-parts, to which it first adheres, and transporting it to the pollen-baskets, or corbiculæ, of the hind-legs. In this manipulation the fore-legs gather pollen from the mouth-parts and head; the middle-legs from the fore-legs and from the thorax; the hind-legs from the middle-legs and from the abdomen. . . . A little pollen is loaded directly from the middle-legs into the baskets when these legs are used to put down the pollen-masses."

In the March number of *The American Naturalist* Prof. Kellogg, of Stanford University, reviews the results of his laborious investigations into the geographical and "host" distribution of the external parasitic insects commonly known as bird-lice (Mallophaga). Despite their popular name, nearly 100 out of the 1500 known species are parasitic on mammals, although none of those infesting mammals visits birds, or *vice versâ*. Indeed, with a few exceptions in a couple of genera, the mammal-infesting species belong to families distinct from those parasitic on birds; the members of the former group, in adaptation to a life spent among fur instead of feathers, having discarded one of the two terminal claws of the limbs. After referring to the fact that the various species of these parasites are to a great extent restricted to particular species or groups of kindred species of hosts, the author directs attention to the remarkable fact that certain kinds of these lice are to be found on hosts completely sundered from one another by geographical barriers. The European and the American avocets have, for example, two species in common, while the Old World and New World bitterns have one. To explain this the author suggests that the parasitic species has been handed down practically unchanged to its present hosts from their common ancestor, and consequently that the species of bird-lice are much older than the birds they infest.

In a report on wheat experiments in the United Provinces (Bull. 32, 1912, Agricultural Research Institute, Pusa), Mr. H. Martin Leake and Ram Prasad direct attention to the high yields often obtained. Whereas the average outturn of grain per acre for the Fatehpur area is given as 1250 lb. for irrigated, and 600 lb. for non-irrigated land, yields of 1700 to 2000 lb. were often obtained in these experiments, whilst a yield of 2200 to 2400 lb. may be expected under favourable conditions. These relatively high returns are not attributable to the use of manures or to rich soil, but are probably due to the adoption of hot-weather cultivation. Actual experiments show the value of this practice and indicate it to be cumulative in effect.

An interesting account of experiments on the utilisation of pasteurised milk for Cheddar cheese-making has been published by Messrs. J. L. Sammis and A. T. Bruhn (Research Bulletin 27, Univ. Wisconsin Agric. Exp. Stat.). In practice, the processes of cheese-making have been subject to daily variation on account of qualitative and quantitative differences in the initial bacterial flora of the milk, and the resulting product has varied accordingly. The above investigators have now devised a method by means of which these initial differences are eliminated. The milk is first pasteurised at 160° to 165° F., whereby about 99 per cent. of the bacteria are killed; the reaction of the milk is then corrected, by the addition of hydrochloric acid, to 0·25 per cent. acidity (stated as lactic acid); a pure culture of lactic acid bacteria is added, and all subsequent processes can be carried out according to a time schedule. It is also claimed that the quality of the product is more uniform than that of cheese produced by the ordinary method; the cheese may be safely stored at high temperatures; the losses of fat are lower, and the average yield is higher than under ordinary conditions. In addition to providing a means of destroying pathogenic organisms contained in the milk, the method may prove of value in connection with research on the processes of cheese-ripening.

An article by Mr. N. Mori, on the formation of "tree-frost" in northern Japan, appears in the February issue of the Journal of the Meteorological Society of Japan. The author distinguishes this from hoar-frost, which is formed at or about freezing-point, observing that "tree-frost"—which appears on various objects, but principally upon the branches of trees—follows on early morning mist and a temperature of from 10° to 30° below freezing-point. In appearance "tree-frost" is quite different from hoar-frost, resembling white blooms. The author regards the phenomenon as due to the direct freezing on to the tree-branches of the minute watery particles of mist formed at a temperature below freezing-point. Mr. R. Hirano, of the Tadotsu Meteorological Station, has an article on *shigure*, or drizzling rain, in which he seeks to draw scientific deductions from references to the subject in Japanese poetry ranging over a period of more than a thousand years. Among other matters of interest is an account, by Baron Yoshida, of a cloud pillar observed in Kaga province, on the Japan Sea coast, on the afternoon of December 25, 1912. Snow had been falling and covered the ground to a depth of 4 or 5 in., but had ceased, and the sky was clear, with the exception of some cumulo-stratus clouds. Among them a curious ash-white cloud made its appearance, and from this suddenly was seen to rise a whirling column, which moved off in a northerly direction. A smaller column was formed in its rear and followed it at an equal distance. Both columns vanished in about eight minutes, the smaller being the first to disappear.

In the issue of Nature for July 28, 1910 (vol. lxxxiv., p. 118), attention was directed to the method of treating storage cells seriously reduced in capacity by sulphating, which had been used with great success by Mr. J. O. Hamilton, of the Kansas State College. At a recent meeting of the American Electrochemical Society, Messrs. C. W. Bennett and D. S. Cole, of the electrical engineering department of Cornell University, described the results of applying a similar method to the college battery of fifty-two cells, which, owing to sulphating, had a capacity of only 30 instead of its rated capacity of 60 ampere hours. The acid was removed from the cells and replaced by a 10 per cent. solution of pure sodium sulphate. The battery was then charged for 53 hours, and the plates removed, washed, and replaced in their proper acid. The capacity was found to be increased to 58 ampere hours, and the total cost of the treatment worked out at 10*d*. per cell. An abstract of Messrs. Bennett and Cole's communication will be found in *The Electrician* for March 28.

The Journal of the Franklin Institute for March contains an article by Mr. H. T. Herr, of the Westinghouse Machine Company, on recent developments in steam turbines. This article gives an excellent account, with drawings, of the present turbine practice of the Westinghouse Company. The author states that scarcely any turbine of anybody's make ever gave trouble due to blades breaking or coming out because of centrifugal force. Breakages are accounted for by vibrations, and until lashing of the longer blades was resorted to, breaking was caused by individual vibration. The lashing, or shrouding, must not be continuous, as provision for unequal expansion due to heating must be taken account of; hence, all lashed blades must be arranged in segments not exceeding 2 ft. for large diameters. These segments may vibrate as a whole, but the lashing has the effect of increasing the frequency and diminishing the amplitude of the vibrations. Lashing or shrouding is therefore a palliative against vibration, and not a cure. It is the practice of the Westinghouse firm to lash all reaction blades above 1 in. in length, and very long blades may have three or four rows of lashing wire.

As is well known, air in excess of that which is required to ensure complete combustion of the fuel under a boiler carries away heat wastefully to the chimney, and the boiler and its flues are less efficient in absorbing the heat which has been produced. Engineers, therefore, test flue gases for carbonic acid, as an unduly small proportion of this corresponds to unnecessary excess of air. This is generally done by ascertaining the reduction in volume of the flue gas after treatment with a solution of caustic soda. These wet chemical methods, of course, work well enough, but the lower-grade type of engineer does not take kindly to them. The Underfeed Stoker Co., Ltd., of Coventry House, South Place, E.C., however, has put on the market, at a cost of five guineas, an extremely neat pocket apparatus, called the CO_2 thermoscope, in which no liquids are used. A measured charge of the gas is passed through a charge of powdered caustic soda contained in a copper cap looking like a detonator, but sealed at both ends. The ends are first pricked and then the cartridge is placed within the hollow bulb of a mercurial thermometer contained within the instrument. The zero of a sliding scale is then set to the mercury index and the piston of the instrument is pushed home so as to drive the gas through the cartridge of caustic soda. This heats up the cartridge, and the thermometer, acting as a calorimeter, shows directly on the scale the proportion of CO_2 present. Provision is made for eliminating the effect of temperature on the volume of the gas taken. As in the wet process, SO_2 counts as CO_2, but in this case in a higher degree in consequence of the greater heat of combination.

OUR ASTRONOMICAL COLUMN.

The Question of Radium in the Chromosphere.—Bulletin No. 27 of the Kodaikanal Observatory contains an important statement by Mr. Evershed regarding the recent communications concerning the presence of radium and the elements of the inactive group in the chromosphere. One of the recent communications concerned a comparison made by Mr. Dyson of the lines of radium and the emanation with the bright lines in the chromospheric spectrum as observed at eclipses; this comparison indicated many apparent coincidences of wave-length, and he suggested that these elements may be revealed by their emission lines, although not by their absorption lines, as is the case of helium. In the first part of the paper Evershed deals with the comparison of the chromospheric lines with those of radium and the emanation. He employs for the chromosphere the spectra he obtained during the eclipse of 1900 for the ultra-violet region of the spectrum and the spectra (glass positives from the original) secured by Dr. Mitchell at the eclipse of 1905; these latter are, as he states, "the finest that have ever been obtained in the less refrangible region." In the second portion he devotes his inquiry to the question of the presence of neon or argon in the chromosphere, using the wave-lengths of the chromospheric lines as obtained by himself, Lockyer, and Dyson, and discusses the spectra thoroughly.

The result of his inquiry, to use his own words, is to show "that with the best eclipse material now available and the most recent measurements of the lines of the elements in question, the evidence is of a distinctly negative character as regards radium and the emanation, as well as neon and argon, and the probability is that not one of these elements can be recognised in the sun by a study of the emission spectrum of the chromosphere any more than by a comparison with the solar absorption spectrum." He further states that he has also examined the spectra of krypton and zenon, and also finds no evidence for their presence in the chromosphere.

Dedication of the New Allegheny Observatory.—The corner-stone of the new buildings for this observatory was laid by Mr. John A. Brashear on October 20, 1900. The director at that time was Prof. F. L. O. Wadsworth. The work of building and transference has been completed, and the observatory dedicated with religious solemnity and handed over to the trustees of the University of Pittsburgh. We have lately received (Misc. Sci. Papers, Alleg. Obs., N.S., vol. ii., No. 2) an account of the dedicatory exercises and presentation which took place on August 18 of last year, and were referred to in Nature of September 19, 1912 (vol. xc., p. 89). It is a pity that such stimulating scenes do not mark the history of astronomy in England. The various speeches are given in full, and in an appendix is given the speech made when the corner-stone was laid. Happily, Mr. John Brashear, to whose personal endeavours the new observatory owes so much, has lived to see crowned the works he then put in progress.

General Index to the Memoirs of the Society of Italian Spectroscopists.—The fortieth anniversary of the above society and the completion of forty volumes (1872–1911) of the memoirs have been celebrated in a manner "modesta ed utile" by the preparation and publication of an *Indice Generale delle Memorie*. The index is made "per Autori e per Materia." The latter part is not an alphabetical list of titles juggled on the change-ringing system adopted in some catalogues, but consists of a number of natural divisions of the subject forming heads of lists of papers arranged chronologically under author's names. Prof. A. Riccò is responsible for the grouping. Other members of the staff of the Astrophysical Observatory of Catania have assisted.

NATIONAL ASPECTS OF EDUCATION.

SEVERAL notable utterances relating to our national scheme of education have recently been made by Lord Haldane and other members of the Government. Apparently the intention of the Government is to introduce a measure which will organise our educational institutions and forces on a national basis, and in the spirit worthy of a great modern State. Among the developments adumbrated are the raising of the leaving age of compulsory attendance at primary schools, the abolition of the "half-time" system, compulsory attendance at continuation schools, the correlation of primary and secondary schools, improvement of the status of teachers, increased number of provincial universities and of facilities for entering them.

The development of national education along such lines as these signifies a substantial increase of expenditure; and as the contributions from rates for educational purposes have reached breaking-point in most districts, the main part of the increased burden will have to be borne by the State. Since 1870, the proportion of the cost of education borne by the rates, in comparison with that contributed from national sources, has grown very considerably; and a readjustment of the load is imperative. Lord Crewe referred to this disproportion in the course of a speech at a dinner given to Lord Haldane by the Eighty Club on April 4, and he remarked:—"We cannot coordinate our system without incurring a heavy cost, and the question the Government will have to put is: Is the country prepared, when it has seen our proposals, to say that the benefits which those proposals offer justify a further expenditure, which cannot be small, upon national education." Lord Haldane has also acknowledged (in his speech at Manchester in January last) that "One thing is quite certain—what is about to be done for the coming generation must not be done at the expense of the ratepayer." In various speeches since the opening of the campaign at Manchester he has referred to the national responsibility for the development of our educational resources, and the national advantages which will accrue from it. Speaking at a joint meeting of secondary-school and technical teachers at the University of London on March 29, he said:—"The expenditure on education is productive expenditure, which we are justified in making a sacrifice to incur with the certainty that we shall get it back with compound interest."

It is refreshing to find our Ministers accepting the principle that increased provision for education must come from the State, and that the nation will benefit by the additional expenditure. Not many years ago Lord Haldane, in an introduction to Sir Norman Lockyer's collection of addresses on "Education and National Progress" (1906), suggested that the private donor should be encouraged, but that the motto of the Chancellor of the Exchequer as regards expenditure upon matters connected with higher education and research should be *Festina lente*. "I do not mean," he wrote, "that the Government ought not to spend public money generously upon the universities. I mean that it should not be spent unless and until a case for the necessity of such expenditure has been clearly made out."

We may be permitted to conclude from his recent utterances that Lord Haldane is now of the opinion that a case has been made out for increased national provision for our educational forces. He knows as well as anyone that the great advances being made in education in other countries constitute a formidable menace to ourselves, and that the State can wait no longer for like developments if it desires to maintain a leading position among progressive peoples. What Lord Haldane and other members of the Government have been saying recently as to the responsibility of the State for educational progress has not only been said in New South Wales, but put into practice by the Labour Government now in power. The official pronouncement of the New South Wales Government upon education may appropriately be quoted here; it reads:—

"The present Government, recognising that economic reforms are of little value without increased educational facilities, attaches supreme importance to educational reforms. 'A man might have access to land, facilities of travel, industrial energy, credit, economic security, and justice, and yet true equality of opportunity might be lacking. The society where all these liberties have been won might be sunk in the stagnation of conservatism, and might even breed new forms of inequality and tyranny.' Every improvement in economic conditions should be accompanied by an effort to raise the standard of intelligence, and this will only be achieved by the State recognising its ever-increasing responsibility to provide increased educational facilities."

The article by Prof. H. S. Carslaw in NATURE of April 3 shows how the policy outlined in this manifesto has now been carried out in New South Wales; and the reforms there instituted are much the same as those urgently needed in the mother-country. To attempt to describe in detail the many directions in which our educational system requires organisation, improvement, and extension would take the present article beyond reasonable limits, but reference may be made to a few matters mentioned in recent speeches.

Much has been said of the work of the elementary school in relation to after-life. The great difficulty here is to know what the life after school is to be. More than 40 per cent. of the boys leaving London schools go into irregular employment; not so much perhaps on account of any want of fitness to learn a trade as because of the ease with which such "blind-alley" occupation can be found, and the relatively higher wages which can be obtained. It is not the province of the elementary school to prepare for any particular occupation, but so far as possible to guide the child to appreciate what is best in life, to train his hand and eye to work together, and to make him trustworthy, alert, and adaptable in whatever calling he may be placed. There should certainly be more manual work in schools, but its aims and methods should be educational and not technical. To attempt specialisation in an ordinary school, from which the boys leave to enter fifty or more different occupations, would lead to hopeless confusion. Manual dexterity can be trained in schools at an age when it is most easily acquired without attempting to teach the processes of particular occupations. The effect of giving more time and attention to work of this practical nature would perhaps be to increase the dignity of manual labour, and to lead ambition into industrial rather than clerical directions.

In rural districts the difficulty in making the elementary-school curriculum less bookish is the teacher, who frequently has no special aptitude for the work, and has rarely received a special training. So long as there is no inducement for teachers to qualify themselves for work in rural schools, no improvement can be anticipated. At present the rate of pay is lower than in town schools and the opportunities of advancement are fewer; so that young teachers naturally object to become earmarked for country schools. Exceptional qualifications are demanded without any inducement being offered to teachers to obtain them. The teacher in a rural school is expected to have the spirit of a naturalist, the manual dexterity of an artisan, the experience of a horticulturist, and the culture of a university graduate, and for these admirable qualities he will receive the pay of a second-rate clerk. It is unreasonable to expect that many men and women possessing such attributes will have no higher ambition than that of teaching in country schools.

One of the reforms contemplated by the Government is the raising of the age below which attendance at school is compulsory, and the abolition of the "half-time" system. At present, a child can leave school immediately it reaches the age of fourteen years, irrespective of the standard in which it may be at that time. About 10 per cent. of the children in public elementary schools leave each year, and they are usually in Standard VI., so they have had the full opportunities of whatever education the schools are giving. Partial exemption from school in order to go to work during certain hours of the day can be obtained at the age of twelve by obtaining an attendance certificate, or at eleven in agricultural districts if the standard of exemption fixed by the local education authority has been passed. This is the "half-time" system, and in the year 1910–11 the number of children who took advantage of it was 71,475, 80 per cent. of whom belong to the districts of Lancashire and Yorkshire engaged in textile industries. The total number of pupils in attendance at public elementary schools of England in the year 1910–11 was nearly 5,000,000, so that the "half-timers" form only about 1½ per cent. of the children under instruction, and since the year 1907–8 the number has been continually decreasing.

Little can be said in favour of the "half-time" system from the point of view of the child's physical, mental, and moral development, all of which are sacrificed by it to the interests of some parents and employers. The facts described in the work on "Continuation Schools in England and Elsewhere," edited by Dr. M. E. Sadler, provide an unanswerable indictment of the system by which child-labour is exploited because it is cheap and the educational discipline of school is minimised at a period when it is most needed.

Several attempts have been made to abolish the half-time system, the most recent being the Education (School Attendance) Bill, which was introduced in the House of Commons last year, and was afterwards sacrificed. The Bill provided that no child under the age of thirteen should be allowed to leave a public elementary school, and that a child should only be allowed to leave school before the age of fourteen for the purpose of entering into some beneficial employment. It was left to the local education authority to decide whether the conditions of the proposed employment were suitable to the child, and whether it was likely to lead to permanent employment and to afford useful training.

It may be possible to find arguments in favour of permitting a child to leave school relatively early in order to enter employment which will make him a skilled workman, but no amount of special pleading will prove that a child of twelve is benefited by working six hours in a mill each day and attending school for two and a half hours as well. When the school curriculum is of a more practical character than it is at present—and many education authorities are making it so—it will not be reasonable to urge, as Sir William Anson did last year, that the mechanical drudgery of the mill-room is more valuable for after-life than instruction in educationally-graded courses of manual work and housecraft.

The great majority of children who leave the elementary schools receive no further school training. The following table, based upon the statistics prepared for the Board of Education by the Continuation Schools Committee which was appointed in 1907, gives some indication of the numbers of adolescents receiving no regular education:—

Boys and Girls (England and Wales), 1906–7.

Age	Population	Not at school (either day or evening) No.	Per cent.
12	687,300	14,424	2·10
13	690,300	155,871	22·58
14	691,000	442,950	64·10
15	682,100	523,383	76·73
16	649,200	532,016	81·95
17	664,900	557,632	86·87

It is a common complaint that what is learnt in school is soon forgotten in after-life. This is true of most subjects and of most children; and the loss of the knowledge is usually the result of disuse. The above table shows that a very small proportion of children from elementary schools continue their education by attendance at continuation schools, the result being that in most cases they are unable after a couple of years to perform the simplest arithmetical calculation or show evidence of having received instruction in any ordinary subjects other than reading and writing. This is a bad beginning for after-life, and the nation will benefit by any measure which will bring pressure to bear upon parents and employers to ensure attendance at continuation schools. In Germany, twenty-seven States have adopted the compulsory continuation-school system, which imposes the statutory obligation on all employers of labour to give their employees under eighteen years of age such leave of absence from work for the purpose of attending the schools as the local authorities may prescribe. It is time that similar measures were adopted in our own country. The years of youth and adolescence, when supervision, discipline, and guidance are particularly needed, are at present left unguarded by the State. It is true that we have in the three-quarters of a million students who attend evening and similar schools an army of voluntary students of which any nation may be proud, but nearly one-fifth of these students fail to complete the small minimum of attendances (from thirty to sixty hours) required to enable grants to be claimed towards their instruction, and most of the remainder only receive very elementary instruction, comparable perhaps with the work of continuation and trade schools in Germany, but forming no satisfactory substitute for the highly developed system of secondary and technical education in that country.

We do not suggest that the education system of Germany is adapted to the needs of our own country and people, but we do believe that until a national system of our educational institutions has been formulated comparable with that of our chief competitor, it will not be possible to inspire confidence in the expenditure of large sums of public money on education. We go to Germany for our illustrations because there the result of organisation by the State has been to raise education out of the slough of commercialism and make the people appreciate its advantages to the nation and the individual. If comparison with Germany is permissible in the case of armaments, it is much more so in connection with education, in which we ask, not for two schools to one, but an approach to equality.

In true secondary schools, high-grade technical institutions, and advanced university students lie our weaknesses as compared with Germany. There are nearly 1000 recognised by the Board of Education as efficient secondary schools in England and Wales, and they are attended by about 170,000 boys and girls, three-fifths of whom are from public elementary schools. Three-quarters of these pupils are, however, under fifteen years of age, and if pupils under twelve years of age be left out of consideration the average length of the secondary-school life is less than three years. Germany has in its secondary schools more than twice as many pupils as are in our State-aided secondary schools, and all taking courses lasting six or nine years, leading to definite goals and linked up closely to the public life. The leaving certificate obtained after passing through a nine-years' course qualifies for entrance into any German university, and to any of the learned professions. We have no such general certificate for the pupils of our secondary schools, and the standard of the certificate could not be passed successfully by the majority of the students in our universities, while to apply it to the product of our schools at present would be impossible.

With few exceptions, our technical institutions also will not bear comparison with the technical high schools of Germany, either as regards number of students or nature of the instruction. The total number of day technical students in English polytechnics, technical schools, and colleges, and in universities and university colleges recognised as technical institutions by the Board of Education, is about 4000; and less than one-fifth have passed a university matriculation examination or its equivalent upon entrance. Less than 2000 day students are taking full courses of instruction in technical institutions in England and Wales, though this number includes students of technology in several provincial universities or university colleges. The technical high schools of Germany and Zurich have together more than six times as many day students taking full four-year courses, after having completed a full secondary-school course and obtained the leaving certificate. If the same standard were required for entrance to our technical institutions, most of them would cease to exist.

Our position as regards university students is equally unsatisfactory when compared with that of Germany. In the whole of the universities of England, including Oxford and Cambridge, there are about 17,000 full-time students, whereas Germany has four times as many. The University of Berlin alone has 10,000 matriculated students; Leipzig 5000; Bonn, Breslau, and Halle more than 3000 each, and six other universities more than 2000. We have a long journey to make before we can approach the position occupied by Germany as regards secondary, technical, or university education, and it is the State which must take the lead if we are to make up our leeway. The first requirement is to organise our educational institutions into a truly national system; that is to say, upon a system which has the well-being of the nation as its main object, and in which facilities are offered to every individual to secure the highest instruction if he is qualified to take advantage of it.

The raising of the leaving age of elementary schools, the abolition of the "half-time" system, the establishment of compulsory continuation schools, and the coordination of elementary and secondary schools are reforms for which England ought no longer to wait, but of greater importance from the point of view of national progress is the development of higher technological instruction and research in our technical colleges and universities. The importance of this was emphasised by Mr. H. G. Wells in three articles contributed to *The Daily Mail* on April 7, 8, and 9. Mr. Wells's theme was the nature of our naval and military armaments and the national expenditure upon these preparations for war; and he urged that too much confidence is placed in obsolescent instruments of destruction and far too little encouragement given to organised technical research, military and naval experiment, and other means by which a secure position can be obtained by the aid of science. "I will suggest," he said, "that we have the courage to restrain and even to curtail our monstrous outlay upon war material, and that we begin to spend lavishly upon military and naval education and training, upon laboratories and experiment stations, upon chemical and physical research, and all that makes for knowledge and leading, and that we increase our expenditure upon these things as fast as we can up to ten or twelve millions a year." The arts of peace, no less than those of war, require the production of as many highly educated, inventive, investigating men as the nation can obtain from all classes of the community. The future of every modern State depends upon the work of its men of science and engineers. Let us hope that this will not be forgotten when the Government gives attention to the organisation of education, and that consideration will be given not only to the acquisition of knowledge by students of various grades, but also to its increase.

R. A. Gregory.

VARIATIONS IN ATMOSPHERIC CIRCULATION IN TEMPERATE LATITUDES.

Dr. A. Defant contributes a long paper to the *Sitzungsberichte der K. Akad. der Wiss. in Wien*, March, 1912, in which he discusses the variations in the meteorological elements in temperate latitudes in both hemispheres. In an introductory section he outlines the theoretical conclusions on which he bases his method of investigation. Briefly stated, they are as follows. If a region is a region of rising pressure, a "Steig-gebiet" in the nomenclature of Ekholm, the mean temperature of the atmosphere is below normal, and *vice-versa* if it is a region of falling pressure; but the precipitation is a maximum if the temperature of the atmosphere is above the normal over the region, and a minimum if the temperature is below the normal. Consequently oscillations in the precipitation correspond with oscillations in the variation of pressure, and if the first are periodic, the second will have the same periods.

The argument is ingenious, and would be unquestionably valid if the correlations were complete, but the question naturally suggests itself: "Why not investigate directly the records of pressure, which is less subject to local influences than is the amount of rainfall?" The paper appears to contain no adequate reason against adopting the direct method, but as rainfall is a more important climatic factor than pressure, the results of the investigation have an interest of their own, apart from the theoretical development.

The author has taken the daily weather reports for South America and Australia for the year 1904, added together the published values of rainfall for each day for all stations, and taken the total so obtained to represent the daily rainfall of the region considered. The totals are then written down in series, and the number of maxima during the year is counted and divided into the number of days. In this way an approximate period is obtained. The variation of this period is then eliminated, and the process repeated to give the next period. The method is clearly a rough one, and some discussion of the significance of the periods obtained appears to be necessary. Nevertheless, the results are interesting, and suggest that the application of Schuster's method of analysis to the search for comparatively short periods would repay the labour involved. Defant obtains periods of about seven, twelve, sixteen, and thirty-one days for the southern hemisphere, and by using the values for 1909 finds corresponding periods of about six, thirteen, and twenty-five days in Europe. It may be noted that Turner found evidence of a period of twenty-five days in his analysis of the Greenwich records.

Using some results of Exner's on the effect of the different thermal conditions over land and water, the author finds that a continent is the source of a series of pressure waves which travel from west to east with a velocity independent of the wave-length, and he connects this series of pressure waves with the variation of rainfall. The most important waves are those of which the lengths in degrees of longitude are 360°, 180°, 120°, &c., while next in importance are those of which the length is half the width of a continent or ocean. Their velocity is about 11° of longitude per day in the southern hemisphere, 14·5° per day in the northern. It is clear that if the results of the author's investigations are valid, they will be of great importance in long-distance forecasting.

E. Gold.

GYROSTATS AND GYROSTATIC ACTION.[1]

I NOW suspend the gyrostat from the horizontal beam by means of this chain terminating in a hook (Fig. 8), which engages, as you see, in a central recess of the rim attachment. The chain, you observe, carries a ball-bearing race. I place the gyrostat with its axis horizontal and leave it to itself. The centre of gravity of the gyrostat lies vertically below the hook, and under those conditions there is no couple tending to tilt the instrument. I transfer the hook to one of the side recesses, set the gyrostat so that its axis is horizontal, and leave it to itself, when instead of falling down it turns its axis in a plane which is nearly horizontal. If I delay the precessional motion the gyrostat descends, if I accelerate the precession the gyrostat ascends. I transfer the hook to

Fig. 8.—Motor-gyrostat precessing on chain support.

the opposite side recess, place the gyrostat so that its axis is horizontal, and again let go. The gyrostat precesses as before, but in the opposite direction. Again I hurry the precession, and again the gyrostat rises; again I delay the motion, and the gyrostat descends.

In these experiments, when the hook engages in either of the side recesses there is a couple due to gravity tending to produce angular momentum in a vertical plane. The axis of spin-momentum turns towards an instantaneous position of the couple-axis at right angles to it, at angular speed ω say. If μ be the spin-momentum, and the top has been properly started, angular momentum *about the couple-axis* is being produced at rate $\mu\omega$ by this turning, and this is equal to the moment of the couple. The precessional motion remains at the value required to give just the rate of production of angular momentum corresponding to the couple. This is the point generally missed in popular explanations of gyrostatic action.

It is important to notice, however, that, as these experiments are usually carried out, the precession, though apparently steady to the eye, is not, strictly speaking, perfectly steady. There is a very slight alternate rise and fall of the axis. To get quite steady motion the top must not be simply spun and then left to itself; it must be started with the right amount of precession.

I now place the gyrostat within this wooden tray (Fig. 9). The pivots carried by the rim of the gyrostat engage on bearings provided in the tray, and these are on a level with the centre of gravity of the whole. I hold the tray so that its plane is horizontal, and carry it round in a horizontal circle. Nothing happens. Still holding the tray so that its plane is horizontal, I carry it round in a horizontal circle in the reverse direction. The gyrostat immediately turns a somersault, and is thereafter stable. If I reverse the direction of rotation of the tray again the gyrostat turns a somersault, and remains again quiescent.

The gyrostat is stable, with its axis vertical, so long as the direction of spin coincides with that in

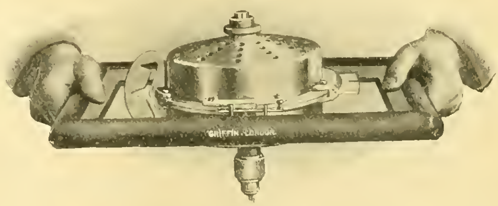

Fig. 9.—Motor-gyrostat mounted to demonstrate the principle of the gyrostatic compass.

which the tray is being turned. If this latter direction is reversed the gyrostat turns a somersault so as to render the two directions coincident. It appears as if the arrangement had a will of its own, and refused to be carried round against its direction of spin.

The theory of this experiment is very instructive. Both cases are represented by one differential equation, but in one case there is a real period of vibration about the vertical; in the other the period is mathematically unreal, and the gyrostat axis moves further away from the vertical. No better illustration of the two cases of the equation can be found.

The behaviour of the tray-gyrostat is exemplified also in the gyrostatic compass. A heavy and rapidly rotating flywheel is mounted so that its axis is maintained horizontal by means of an elastic support. Under these conditions the equilibrium position of the flywheel under the horizontal component of the turning velocity of the earth (which corresponds to the turning of the tray) is arranged to be that in which the axis of rotation points due north and south. If time permitted, I should be glad to make an experiment with a carefully balanced motor-gyrostat which would not only show the turning of the earth under the gyrostat, but enable the rate of turning to be measured.

[1] Discourse delivered at the Royal Institution on Friday, February 14, by Prof. Andrew Gray, F.R.S. The motor-gyrostats described are the invention of Dr. J. G. Gray and Mr. G. B. Burnside. The gyrostatic tops and combinations used in the latter part of the lecture are due to Dr. Gray. Continued from p. 153.

I would now direct your attention to this motor-gyrostat, which forms the bob of an ordinary compound pendulum (Fig. 10). The tube carrying the gyrostat is attached, by means of a universal joint,

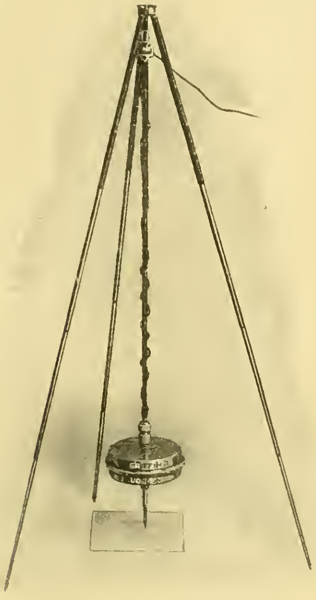

FIG. 10.—Motor-gyrostat fitted up as a gyrostatic pendulum.

to the apex of a triangular stand, made of telescope tubing. The gyrostat is attached to the lower end of its supporting tube by means of a special cap provided with spring contact pieces to allow the current to be led into the motor, and the flywheel is free to rotate about an axis coincident with the rod. Screwed to the lower side of the gyrostat is a pen, which presses lightly on a card placed below.

We have now the pendulum rod in the vertical position. I draw the pendulum to one side and let go, when you see that it vibrates to and fro, and the pen traces out a straight line on the paper. The flywheel has as yet no spin. I start the flywheel revolving, draw the pendulum to one side, and let go, either from rest, or with a certain amount of sidelong motion, when you observe that the pen describes a flower-shaped path (Fig. 11). The path is shown for different amounts of sidelong motion. The peculiar appearance of these curves is due to the rapid falling off of amplitude produced by friction.

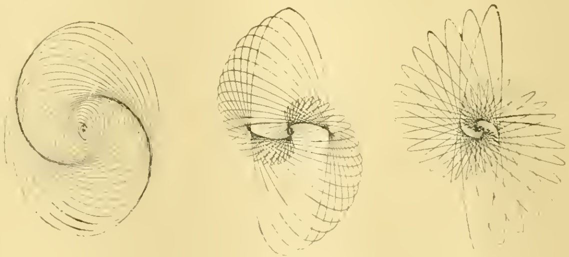

FIG. 11.—Some curves obtained with the gyrostatic pendulum.

When the flywheel is revolving there are, in general, two couples acting on the pendulum, one due to gravity, the other due to gyrostatic action. At an instant at which the axis of the gyrostat is vertical the former couple is zero and the latter one is a maximum, for at that instant the angular velocity with which the axis of the gyrostat is changing direction is greatest. When the pendulum is at one extremity of its swing the former couple is a maximum and the latter one is zero. At that instant the deflection of the bob from the vertical is a maximum, and it is at rest, or is moving sideways, according to the mode of starting, except in so far as the initial conditions have been interfered with by friction. By this relation of the couples the form of the path can be explained.

Another mode of motion is possible which has a very intimate connection with the theory of the vibrations of light-emitting molecules in a magnetic field, as indeed I pointed out here several years ago in a Friday evening discourse (see NATURE, April 13, 1899, and August 24, 1899). The bob can be made to move in a circle about the vertical through the point of support either with or against the direction of rotation of the flywheel. The two periods are different, and the motions correspond to the circularly polarised light of two distinct periods, which molecules, situated in a magnetic field, are found to emit. Thus the gyrostatic pendulum gives a dynamical analogue of the cause of the Zeeman effect.

In 1907 Herr Otto Schlick introduced a method of employing a gyrostat to counteract the rolling of a vessel at sea. The gyrostat is carried on bearings placed athwart the ship. These bearings are in line with the flywheel, and a weight is attached to the frame of the gyrostat in a position in line with the axis. It will be seen that when the ship is on even keel the gyrostat rests with its axis vertical, and with the weight vertically below the centre of gravity of the flywheel. Heeling of the ship in one direction causes the gyrostat to precess in one direction on the bearings on which it is mounted; heeling in the other direction causes precession in the opposite direction, and couples resisting the rolling motion are brought to bear on the ship. The device may be employed in two ways. In the first place, if the bearings on which the frame of the gyrostat is carried within the ship are smooth, the effect of the gyrostat is to resist the rolling force of the waves, and to bring about a lengthening of the free period of the ship, according to a mathematical theory which, when put in the proper way, is really very simple. Excessive rolling of a ship is due to the cumulative action of the waves, and such cumulative action is only possible where the period of the ship and that of the waves are of about the same order. A large ship has a very long period, and synchronism of the ship and the waves is impossible. The effect of introducing a gyrostatic control, operated in the manner just described, is to endow the small ship with the period of a very large one.

In the second mode of operating the gyrostat, friction is introduced at the bearings on which the frame

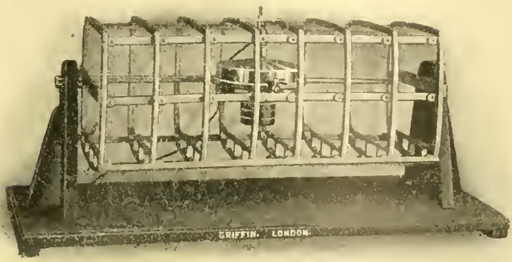

Fig 12.—Motor-gyrostat fitted up to demonstrate Schlick's method of steadying a ship in a cross sea.

of the gyrostat is mounted. With this addition the ship is forcibly prevented from excessive rolling. In the trials of the device it was found that with the control in operation the angle of roll of the ship did not exceed 1° in a cross-sea which produced a total swing of 35° when the control was out of action. It is interesting to notice that, contrary to the opinions which were expressed when the device was first suggested, the preventing of the rolling of a ship does not result in the waves breaking over her; a ship controlled by a gyrostat is, I believe, a dry one.

I have here a motor-gyrostat fitted within a skeleton frame representing a ship (Fig. 12). The frame is mounted on two bearings arranged on wooden uprights, and may be made to oscillate on these bearings, so as to imitate the rolling of a ship in a cross-sea. The frame of the gyrostat is mounted on two bearings placed athwart the frame, and a weight is attached to the outside of the case in a position in line with the axis of the flywheel. The centre of gravity of the gyrostat is in line with the bearings. A clip-device is provided which allows the gyrostat to be clamped to the skeleton frame, and provision is made whereby a graded amount of friction may be applied at one of the bearings.

I now set the skeleton frame vibrating with the flywheel at rest. You observe the period. I start the motor-gyrostat, and repeat the vibrations, with the gyrostat clipped to the frame. The ship rolls precisely as before. I free the gyrostat from the frame, and again set the ship rolling, when you see that not only is the period vastly increased, but the rolling motion is quickly wiped out.

When the gyrostat is clipped to the frame it produces no effect upon the rolling motion. The couples opposing the rolling motion arise from the precessional motion, and hence the gyrostat must be given freedom to precess. In this connection it is interesting to observe that in 1870 it was proposed by Sir Henry Bessemer to obtain a steady cabin for a cross-channel steamer by placing it on a gyrostat with its axis vertical and supported on fore and aft trunnions. This plan was bound to fail. The dependence of the effect on freedom of the axis to precess in a direction which is not that of rolling was not understood. We now see that the object would have been attained by supporting the cabin on fore-and-aft trunnions and mounting the gyrostat, within the cabin, on trunnions placed athwart the ship.

Here is a monorail top of new design (Fig. 13). The frame on stilts represents the car, and mounted on pivots placed across the frame is a gyrostat. Carried by a rod fixed to the frame of the gyrostat, and in line with the axis of the flywheel, is a weight. When the frame is placed on the table so that the legs and axis of the gyrostat are vertical, with the weight above the flywheel, the arrangement is doubly unstable without rotation; the system of gyrostat and weight is usually mounted on the pivots, and the entire structure is unstable about the line of contact of the feet with the table. When the flywheel is rotating, however, the top balances on the table. The two non-rotational instabilities have been stabilised.

I now place the top on the table with the legs and axis of the flywheel vertical, but with the weight below the gyrostat. You observe that the arrangement is unstable. Here there is only *one* instability without rotation, and the result is instability with or without rotation.

Here is a stilt top similar to the one just shown, but provided with wheels adapted to engage on a stretched wire. You observe the remarkable balancing power of the arrangement.

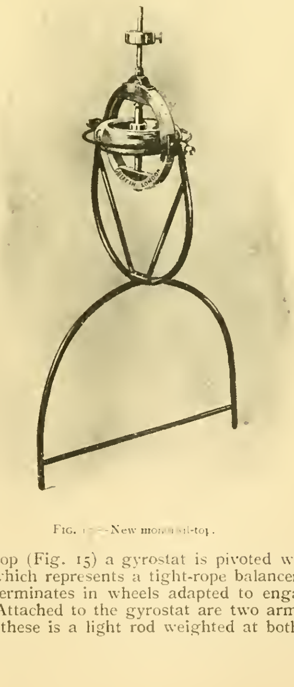

Fig. 13.—New monorail-top.

In this top (Fig. 15) a gyrostat is pivoted within a structure which represents a tight-rope balancer. The structure terminates in wheels adapted to engage on the wire. Attached to the gyrostat are two arms, and carried by these is a light rod weighted at both ends

My assistant spins the flywheel and places the structure upon the wire with the legs vertical and the pole horizontal. The top, as you observe, balances on the wire. If the top tilts over on the wire towards me the gyrostat precesses in the direction which carries

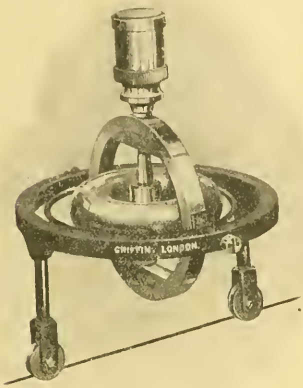

FIG. 14.—Monorail-top on wire.

the pole over towards you, and *vice versâ*. That is, if the balancer begins to fall over to one side it immediately puts over the pole to the other side. The action is exactly that of a tight-rope acrobat.

The rider of a bicycle keeps the machine upright by

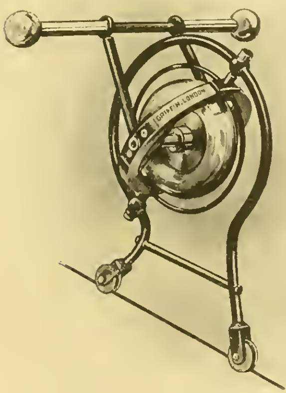

FIG. 15.—Pole-balancing top.

operating the handle-bar. If the machine tilts over to the left the rider turns the handle-bar to the left, and the forward momentum of the bicycle and rider, aided by the gyrostatic action of the wheels (a relatively small factor in this case) results in the erection of the machine. Similarly, if the machine tilts to the right the front handle-bar of the machine is turned to the right.

Here I have a small bicycle of the old-fashioned "high" type provided with a gyrostatic rider. When the gyrostat is spinning rapidly you observe that the top is completely stable. The gyrostat operates the front wheel, just as does the rider on the ordinary bicycle.

Again, here is a small safety bicycle provided with a gyrostatic rider (Fig. 16). In this case the gyrostat is mounted above the back wheel, and is connected by arms to the handle-bar of the front wheel. The action is the same as in the other model.

The tops I have shown you are very interesting from the fact that in each case the gyrostat not only detects but sets about correcting any tendency of the top to fall over. It behaves as if it had both a nervous and a muscular system.

I have also here a gyrostat which can be made to progress in space by a reciprocating motion—in fact, a walking gyrostat (Fig. 17). The gyrostat is suspended by two chains from two horizontally stretched wires. The wires are carried by a wooden frame, which is mounted, as you see, on two trunnions carried

FIG. 16.—Gyrostatic bicycle rider.

by wooden uprights. The chains attached to the arms of the gyrostat terminate in two rings, and these are threaded on the stretched wires.

The gyrostat is spun and replaced on the wires. When the frame is tilted to and fro on the trunnions you notice that the gyrostat walks hand-over-hand along the wires. By the tilting of the frame the weight of the gyrostat is thrown alternately on each of the chains, and in consequence of the precessional motion the gyrostat moves along carrying the chains with it.

At present the spin is great, and therefore the precessional motion is small. The gyrostat proceeds, as you see, with a slow and stately motion. As time goes on the spin falls off, and the rate of walking increases, until finally the gyrostat literally runs along the wires, with considerable loss of dignity. When the gyrostat is enclosed in a box or within an acrobatic figure, the behaviour seems very mysterious.

Here is still another form of acrobatic top, consisting of a large gyrostat, the axis of which is horizontal, and two small ones, with axes vertical, mounted, as you see them, one on each side of the large one, on sleeves threaded on a horizontal bar, as shown in

Fig. 18. My assistant spins the flywheel of the large gyrostat, which is then suspended by means of a string and hook from the upper bar of the frame. At present the centre of gravity of the gyrostat is vertically below the hook, and under these conditions there is no precessional motion. He now spins the two small gyrostats and attaches them to the large one. Each small gyrostat, you will observe, is carried by two sleeves which are threaded on a horizontal bar. The hook is now transferred to one of the side recesses provided in the upper bar of the large gyrostat, and the system is left to itself, when it turns round in azimuth. One of the small gyrostats throws itself up and balances on the bar.

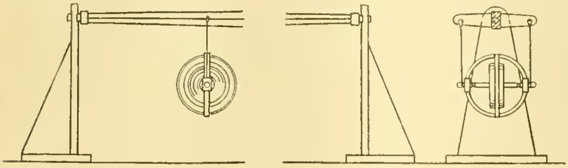

Fig. 17.

The experiment is repeated with the hook engaging in the other side recess, when you observe that the small gyrostat which previously occupied the lower position now rises into the upright one, and the gyrostat which occupied the upright position now occupies the lower one.

This top admits of a large variety of designs. It is easy to imagine a gyrostatic circus rider performing balancing feats on the back of a gyrostatic horse!

I conclude with a gyrostatic model which depends for its action upon an entirely novel and prac-

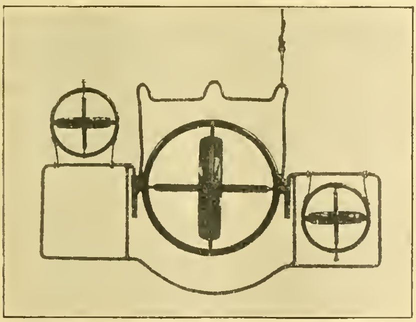

Fig. 18.—Acrobatic top.

tical method of operating a gyrostat or gyrostats. The method has a very large variety of applications, into which I shall not enter at present. It is here shown applied to a motor-car. The car runs on two wheels in tandem; it can be set to run either in a straight path or a path curved in either direction. You observe that the arrangement includes two parts connected by a vertical or nearly vertical hinge. Each is supported on a single wheel. The front part carries a gyrostat with axis horizontal (in this case), the after-part contains the propelling mechanism. A quasi-gravitational field of force is produced by the propeller behind acting through the hinge.

The car can be made to go round in any curve by a weight placed on one side, when it will be seen that it leans over to the inside of the curve.

The balancing power is very great; even when a weight comparable with that of the entire car is mounted on a vertical rod carried by the structure, the device does not fall down. In fact, it is dynamically impossible for the car to overturn.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—It is proposed to confer the degree of Doctor of Law, *honoris causâ*, upon Admiral Sir Wilmot H. Fawkes, G.C.B., and Mr. J. S. Sargent, R.A.; and the degree of Doctor of Letters, *honoris causâ*, upon his Excellency Adolph H. G. Wagner, professor of political economy in the University of Berlin; Sir Frederic G. Kenyon, K.C.B., director and principal librarian of the British Museum; Sir John Knox Laughton, professor of modern history in the University of London; Sir James A. H. Murray; Prof. C. Bémont, professor of history in the Sorbonne; Mr. Thomas Hardy, O.M.; and Mr. Reginald L. Poole, keeper of the archives of the University of Oxford.

Sir Robert Rede's lecturer for the present year, Earl Curzon of Kedleston, will deliver the lecture in the ensuing Michaelmas term, not, as previously announced, in the present term.

The Linacre lecture, at St. John's College, will be delivered by Dr. Norman Moore, on Tuesday, May 6, at 5 p.m., in the lecture-room of anatomy and physiology, New Museums. The title of the lecture is "The Physician in English History."

Mr. W. W. Hornell, formerly of the Indian Educational Service, and now of the Board of Education, has been appointed Director of Public Instruction in Bengal.

The council of the South African School of Mines and Technology has made the following appointments to the staff—Dr. G. S. Corstorphine, consulting geologist, of Johannesburg, to be principal of the school and professor of economic geology; Mr. J. S. Cellier, mining engineer, of Johannesburg, to be professor of mining.

Mr. Pease made his annual statement as President of the Board of Education in the House of Commons on April 10. In the course of his remarks he said that the number of pupils in receipt of free tuition in the 885 secondary schools receiving Government grants last year was 52,563, of whom 49,120 came up from the elementary schools. The staffing of the secondary schools is one teacher to every 32·5; of the elementary schools one teacher to every 13·5. There are twenty training colleges, and their total output of trained teachers last year only reached forty men and 195 women. At the continuation schools only 13 per cent. of the total population under seventeen are in attendance. A course of from two to four years will be established in day trade schools. There is room for twenty more in London and 150 in the country. The 2*l.* 17*s.* per head granted by the Government is wholly inadequate, and Mr. Pease has been able to increase the grant to 5*l.* in land schools and 10*l.* to the various training ships. The Science Museum is about to be built on a site in Exhibition Road, South Kensington. It is proposed to erect the building in three blocks; the foundations of the first block have already been commenced, and about 110,000*l.* will be spent in the erection. Sir Hugh Bell, Sir Henry Roscoe, and other distinguished men of science have undertaken to advise in connection with the scope of this museum, the organisation of the collection, the policy to be followed in regard to the collection to be placed in the new building, and also as to what should be the relation of the museum to other societies and museums.

The final report of the Royal Commission on University Education in London has just been issued as a Blue-book (Cd. 6717, price 2*s.*). The following are among the principal conclusions and recommendations:—(1) The Commissioners consider the whole organisation of the University fundamentally defective —(*a*) because of the present relations between the internal and external sides of the University; (*b*) because of the existing combination in the University of a large number of institutions differently related to it. (2) They propose that external students should continue to be admitted to the general examinations in the United Kingdom in all degrees except those in medicine and technology. Pupils still at school, however, would not be admitted, and students in constituent colleges or in University departments would not be admitted to these examinations in any faculty in which a special examination was open to them without the leave of the proper University authorities. (3) The University in future would consist of constituent colleges and University departments. The constituent colleges will be institutions either established by the University or existing institutions which are strong enough in one or more faculties to comply with the conditions for incorporation, and which transfer to the University the financial and educational control of their work in one or more of these faculties. (4) The normal portal of entrance to the University would be a school examination, established on the lines recommended by the Consultative Committee, instead of the present matriculation. (5) In order to reconstitute the University on these lines an additional income of 99,000*l.* would be required. We hope to deal further with the report in an early issue.

SOCIETIES AND ACADEMIES.

London.

Royal Society, April 10. Sir Alfred Kempe, vice-president and treasurer, in the chair.—L. **Hill** and M. **Flack**: The effect of lability (resilience) of the arterial wall on the blood pressure and pulse curve.—Prof. J. H. **Priestley** and R. C. **Knight**: The nature of the toxic action of the electric discharge upon *Bacillus coli communis.* (1) Electric discharge in air is fatal to bacteria exposed to its action. (2) The effect is due to the products of the interaction of the constituents of the air, namely nitric and nitrous acid and ozone. (3) Discharge in air-free hydrogen has no deleterious effect on the organisms, but the presence of small quantities of air allows the formation of a toxic substance, probably hydrogen peroxide, which again exerts a bactericidal action. (4) It, therefore, follows that electric discharges in which the current density does not exceed 10^{-5} amperes per square centimetre do not exert any directly toxic action upon micro-organisms, a result which is contrary to the statements made by some previous investigators.—S. B. **Schryver**: Some investigations on the phenomena of "clot" formations. Part I. The clotting of milk. —Surg.-General Sir D. **Bruce**, Majors D. **Harvey** and A. E. **Hamerton**, and Lady **Bruce**: (1) Morphology of various strains of the trypanosome causing disease in Nyasaland. II., The wild game strain. (2) Morphology of various strains of the trypanosome causing disease in man in Nyasaland. III., The wild *Glossina morsitans* strain. (3) Infectivity of *Glossina morsitans* in Nyasaland.

Linnean Society, April 3.—Prof. J. Stanley Gardiner, F.R.S., vice-president, in the chair.—Prof. A. **Dendy**: The calcareous sponges collected in the Indian Ocean on the Percy Sladen expedition. Of more than 400 species of Calcarea known, the present collection consisted of thirteen species, several of which were new to science.—Dr. J. D. F. **Gilchrist**: Larval stages of *Jasus lalandii* (Milne-Edwards).—R. S. **Bagnall**: The classification of the order Symphyla.

Royal Astronomical Society, April 11.—Major Hills, F.R.S., president, in the chair.—Mrs. **Evershed**: Some types of prominences associated with sun-spots. The paper was illustrated by forty slides of photographs of various forms of prominences situated over sun-spot groups; the photographs were arranged in eleven series, to show the successive changes in individual prominences. Their motions are intermittent, and vary in amount, thus differing from the motions observed in spot penumbræ, which are uniform and constant. The outward moving gas frequently falls back upon the chromosphere, sometimes forming massive banks, and sometimes rising and falling like fountains.—Miss **Blagg**: A suggested substitute for Bode's law. The law itself and the various hypotheses put forward to supplement it were explained. The author's theory agreed much better than Bode's law with the actual distances of planets and satellites; it strengthened the view that tidal action had always been small, and that satellites had not greatly altered their distances.—Joel **Stebbins**: The selenium photometer. The principle of the instrument, which was in use at the Illinois Observatory, was founded on the fact that the electrical resistance of selenium varied when exposed to light. Many irregularities were found in its use as a stellar photometer, but these were reduced by keeping it at a low temperature; about $-20°$ C. was found most convenient.—Dr. F. W. **Dyson**: The distribution in space of the stars of Carrington's circumpolar catalogue.—E. E. **Barnard**: Observations of the variable star 97, 1910 Cygni, at the Yerkes Observatory. The star, which had a period of nineteen or twenty months, was remarkable for its extreme faintness at minimum, when it was beyond the reach of the 40-in. telescope.—H. C. **Plummer**: Preliminary discussion of the galactic motions of the bright stars of type I.—A. C. D. **Crommelin**: Comparison of the moon's coordinates for 1914, according to the new Delaunay tables, with those given in the Nautical Almanac.

Paris.

Academy of Sciences, April 7.—M. F. Guyon in the chair.—J. **Boussinesq**: The application of the formulæ of superficial viscosity to the surface of a spherical liquid drop, falling slowly, with uniform motion in the midst of an indefinite liquid mass in repose and of a density slightly lower than that of the drop.—M. de **Forcrand**: The dehydration and decomposition of the hydrates of uranyl nitrate. The formation of a monohydrate.—Charles **Depéret**: Observations on the geological Pliocene and Quaternary history of the gulf and isthmus of Corinth.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1912. The results are given in three tables showing the number of spots, the distribution of the spots in latitude, and the distribution of the faculæ in latitude.—Stanislas **Belsetsky**: The stability of equilibrium in a particular case of a piece with constant curvature.—Emile **Jouguet**: The propagation of deflagrations and the limits of inflammability.—Henri **Chrétien**: A variant of the method of coincidences. In the comparison of two chronometers a curious stereo-acoustic phenomenon was observed by means of which the coincidences of the beats could be accurately observed.—A. **Tian**: A new mode of construction of quartz-mercury vapour lamps. A description of a simple form of mercury lamp, easily constructed in the laboratory out of a small transparent quartz test-tube.—Maurice **Billy**: A simple method for determining the density of mineral powders. The adsorbed air on the particles of powder is replaced by carbon dioxide by evacuating and admitting carbon dioxide to the flask containing the weighed powder. A dilute solution of an alkali of known density replaces the water in the density determination. Any carbon dioxide clinging to the powder is dissolved by the solution. Comparative measurements of the density of a solid before and after powdering showed that the accuracy was of the order of 1 in 3000, or about ten times that of the usual method.—Louis **Dunoyer**: A remarkable case of optical resonance. A description of a resonance phenomenon observed in sodium vapour.—L. **Gay**: The adiabatic expansion of liquids. An account of an experimental method for determining the expansion produced in liquids by adiabatic expansion from 2 to 1 atmosphere. —G. **Wyrouboff**: Some observations concerning the note of Mlle. Feytis on the magnetism of anhydrous and hydrated salts. The author regards a hydrated and dry salt as possessing quite different constitutions, and regards the measurements of Mlle. Feytis as confirming these views.—M. Emm. **Pozzi-Escot**: A new double sulphate of silver and cerium. The new salt has the composition $10Ce(SO_4)_2.6Ag_2SO_4$.—A. **Colani**: The solubility of thorium oxalate. Data are given for the solubilities in hydrochloric and oxalic acids.—Paul **Lebeau** and Marius **Picon**: The action of monosodium acetylene upon the alcoholic iodides. The preparation of true acetylenic hydrocarbons The sodium derivative of acetylene is prepared by the action of acetylene upon sodammonium in solution in liquid ammonia at $-50°$ C. The alkyl iodide is added to this solution and a quantitative yield of the alkylacetylene is obtained. Details of the preparation of allylene and hexine by this method are given.—F. **Bodroux**: Catalytic ester formation in dilute solution; the preparation of ethyl acetate. In presence of a suitable catalyst ethyl acetate is formed from alcohol, and acetic acid in dilute solutions of sulphuric acid.—E. C. **Teodoresco**: The action of high temperatures on dried nucleases of plant origin. The dried nucleases of the three plants studied do not lose all their activity towards sodium nucleate until after thirty minutes' heating to temperatures varying between 141° C. and 162° C.—Maurice **Lenoir**: The commencement of vascular differentiation in the plantule of Veronica.—Marcel **Dubard** and J. A. **Urbain**: The influence of the albumen on the development of the embryo. The albumen is not indispensable to development, but its influence is favourable, especially during the first days of germination. —L. **Armand**: The kinetic phenomena of the heterotypical prophase in *Lobelia crinus*.—M. **Marage**: The inscription of the respiratory movements by means of the hand.—Edgard **Hérouard**: The relations between the depression and formation of the tentacular pseudoplanula in the Scyphistome.—A. **Quidor**: *Lamarckina caligusa* and the evolution of the Lernæidæ.—F. **Picard**: Parthenogenesis in *Phthorimaea operculella*.—Lucien **Cavel**: Sulphur and its variations in the biological treatment of sewage. The determination of combined sulphur in sewage which has passed through various stages of purification throws some light on the proportion of unattacked albumen. The combined sulphur in a sewage effluent should be very small, if the purification has been properly carried out.—M. **Mazé**: The alcoholic fermentation of lactic acid. The organism employed caused the destruction of nearly all the lactic acid present; alcohol and formic acid are the primary products, but the alcohol is acted on and acetic acid formed.—Em. **Bourquelot** and M. **Bridel**: The synthesis of galactosides of alcohols by means of emulsin; β-methylgalactoside and β-allylgalactoside. A description of the preparation and properties of these two galactosides, the latter being new.—Henri **Dominici**, Mme. Simone **Laborde**, and Albert **Laborde**: Study on the injection of radium salts. Radium salts are eliminated from the system with extreme slowness. —Jacques **Deprat**: The succession of the Permian and Carboniferous strata in Indo-China. — Edmond **Bordage**: Researches relating to the extension of the nummulitic sea on the right bank of the Gironde.—A. **Leclère**: The genesis of sedimentary iron minerals.

BOOKS RECEIVED.

Anthropological Report on the Ibo-speaking Peoples of Nigeria. By N. W. Thomas. Part i., Law and Custom of the Ibo of the Awka Neighbourhood, S. Nigeria. Pp. 161+xxx plates. Part ii., English-Ibo and Ibo-English Dictionary. Pp. vii+391. Part iii., Proverbs, Narratives, Vocabularies, and Grammar. Pp. vi+199. (London: Harrison and Sons.)

The Distinction between Mind and its Objects. By Dr. B. Bosanquet. Pp. 73. (Manchester University Press.) 1s. net.

Memoirs of the Geological Survey, Scotland. The Geology of Upper Strathspey, Gaick, and the Forest of Atholl (Explanation of Sheet 64). By G. Barrow, L. W. Hinxman, and E. H. C. Craig. With contributions by H. Kynaston. Pp. vi+116+iv plates. (London: H.M.S.O.; E. Stanford, Ltd.) 2s.; map, 2s 6d.

Memoirs of the Geological Survey, England and Wales. (Explanation of Sheet 349.) The Geology of the Country around Ivybridge and Modbury. By W. A. G. Ussher. With a chapter on Altered Rocks by G. Barrow. Pp. vi+137+vi plates. (London: H.M.S.O.; E. Stanford, Ltd.) 3s.; map, 1s. 6d.

Tropical Diseases Research Fund. Report of the Advisory Committee for the Tropical Diseases Research Fund for the Year 1912. Pp. 198. (H.M.S.O.; Wyman and Sons, Ltd.)

Verhandlungen der K.K. Geologischen Reichsanstalt. Jahrgang 1912. No. 1 bis 18. (Vienna: R. Lechner.)

Neue Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Band xlvii. Pp. v+309+plates. (Zurich: Zürcher and Furrer.)

Forty-fourth Annual Report of the American Museum of Natural History for the Year 1912. Pp. 208+plates. (New York.)

"Red Books" of the British Fire Prevention Committee. No. 173, Fire Tests with Doors. Reinforced-Concrete Doors. Pp. 28. (London: The British Fire Prevention Committee, 8 Waterloo Place.) 3s. 6d.

Commercial Gardening. Edited by J. Weathers. In 4 vols. Vol. i., pp. xii+239. Vol. ii., pp. xii+235; vol. iii., pp. xii+240; vol. iv., pp. xii+244. (London: The Gresham Publishing Company.) Four vols., 36s. net.

Allen's Commercial Organic Analysis. Edited by W. A. Davis and S. S. Sadtler. Vol. iii. Fourth edition. By the Editors, E. F. Armstrong, G. C. Jones, A. E. Taylor, G. Barger, and others. Pp. xi+563. (London: J. and A. Churchill.) 21s. net.

Mitteilungen der Naturforschenden Gesellschaft in

Bern aus dem Jahr 1912. Pp. xlvi+349+3 plates. (Bern: K. J. Wyss.)

Ministère de l'Agriculture. Direction Générale des Eaux et Forêts. 2e Partie. Eaux et Améliorations Agricoles. Service des Grandes Forces Hydrauliques dans la Région des Alpes. Tome v. Résultats des Etudes et Travaux à la Fin de 1911. Pp. 530. (Publisher's name not given.)

A Course of Elementary Workshop Drawing. By H. A. Darling. Pp. vi+172. (London: Blackie and Son, Ltd.) 1s. 6d.

The Origin and Antiquity of Man. By Dr. G. F. Wright. Pp. xx+547. (London: J. Murray.) 8s. net.

The Important Timber Trees of the United States. By S. B. Elliott. Pp. xix+382. (London: Constable and Co., Ltd.) 10s. 6d. net.

The Potato. By E. H. Grubb and W. S. Guilford. Pp. 545. (London: Constable and Co., Ltd.) 8s. 6d. net.

Handbuch der Arbeitsmethoden in der anorganischen Chemie. By Dr. A. Stähler. Erster Band. Pp. xii+786. (Leipzig: Veit and Co.) 25 marks.

Annales de l'Observatoire National d'Athènes. By Prof. D. Eginitis. Tome vi. Pp. 333+plates. (Athens: A. Raftanis.)

Abel's Laboratory Handbook of Bacteriology. Second English Edition. By Dr. M. H. Gordon and others. Pp. xi+251. (London: H. Frowde and Hodder and Stoughton.) 5s. net.

Missouri Botanical Garden. Twenty-third Annual Report. Pp. 207+7 plates. (St. Louis, Mo.: The Board of Trustees.)

L'Uomo Attuale una Specie Collettiva. By V. Giuffrida-Ruggeri. Pp. viii+192+xiii plates. (Milan: Albrighi, Segati e. C.) 6 lire.

Mitteilungen aus den deutschen Schutzgebieten. Edited by Dr. H. Marquardsen. Ergänzungsheft, Nr. 6, Ergebnisse einer Reise durch das Zwischenseengebiet Ostafrikas 1911. By H. Meyer. Pp. iii+127+viii plates. (Berlin: E. Siegfried Mittler und Sohn.) 3.60 marks.

Die antike Tierwelt. By O. Keller. Zweiter Band. Pp. xv+618+2 plates. (Leipzig: W. Engelmann.) 17 marks.

The Continents and Their People. Asia: a Supplementary Geography. By J. F. and A. H. Chamberlain. Pp. vi+198. (London: Macmillan and Co., Ltd.) 3s.

DIARY OF SOCIETIES.

THURSDAY, APRIL 17.

ROYAL SOCIETY, at 4.30.—The Luminosity Curves of Persons having Normal and Abnormal Colour Vision: Dr. W. Watson.—The Reflection of X-Rays by Crystals: Prof. W. H. Bragg and W. L. Bragg.—A Fluorescence Spectrum of Iodine Vapour: Prof. J. C. McLennan.—The Relation between the Crystal-symmetry of the Simpler Organic Compounds and their Molecular Constitution. I.: Dr. W. Wahl.

ROYAL INSTITUTION, at 3.—The Progress of Hittite Studies. I. Recent Explorations: Prof. J. Garstang.

INSTITUTION OF MINING AND METALLURGY, at 8.—Notes on Some Bulgarian Mineral Deposits: H. K. Scott.—Notes on the San Francisco Mill, Pachuca, Mexico: J. P. Holcombe.—Errors in Sampling and Assaying Ores due to the Presence of Coarse Gold: F. White.

ROYAL SOCIETY OF ARTS, at 4.30.—The Burma Oil Fields: N. G. Cholmeley.

LINNEAN SOCIETY, at 8.—An Account of the Plants Collected by Mr M. P. Price on the Carruthers-Miller-Price Expedition through North-west Mongolia and Chinese Dzungaria: M. P. Price and N. D. Simpson.—The Flora of the Island of Shikotan: Hisayoshi Takeda.

FRIDAY, APRIL 18.

ROYAL INSTITUTION, at 9.—Applications of Polarised Light: Dr. T. M. Lowry.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Presidential Address.—*Discussion*: Volute Chambers and Guide-passages for Centrifugal Pumps: Prof. Gibson.

MONDAY, APRIL 21.

ROYAL SOCIETY OF ARTS, at 8.—Antiseptics and Disinfectants. I.: Dr. D. Sommerville.

VICTORIA INSTITUTE, at 4.30.—The Samaritan Pentateuch, and Philological Questions connected therewith: Rev. J. I. Munro.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Production of Steel Sections and their Application in Engineering Structures: A. T. Walmisley.

TUESDAY, APRIL 22.

ROYAL INSTITUTION, at 3.—The Heredity of Sex and Some Cognate Problems. II.: Prof. W. Bateson.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Weeping God: T. A. Joyce.—Prehistoric and Other Antiquities in the Departments of Vienne and Charente, France: A. L. Lewis.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Assuan Dam: Protection of Down-stream Rock Surface, and Thickening and Heightening: M. Macdonald.

ZOOLOGICAL SOCIETY, at 8.30.—The Polyzoa of Waterworks: Dr. S. F. Harmer.—The Marine Fauna of British East Africa and Zanzibar, from Collections made by Cyril Crossland, in the Years 1901–2. Bryozoa—Cheilostomata: A. W. Waters.—Notes on Albinism in the Common Reedbuck (*Cervicapra arundinum*), and on the Habits and Geographical Distribution of Sharpe's Steenbuck (*Raphiceros sharpei*): Major J. Stevenson-Hamilton.

WEDNESDAY, APRIL 23.

ROYAL SOCIETY OF ARTS, at 8.—The Design and Architectural Treatment of Shops: H. V. Lanchester.

GEOLOGICAL SOCIETY, at 8.—The Fossil Flora of the Pembrokeshire Portion of the South Wales Coalfield: H. Goode.—The Halesowen Sandstone Series of the Southern End of the South Staffordshire Coalfield: H. Kay.

AËRONAUTICAL SOCIETY, at 8.30.—Aëroplane Construction: A. R. Low.

THURSDAY, APRIL 24.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: (1) Protostigmata in Ascidians; (2) The Origin of the Ascidian Mouth: A. G. Huntsman.—Experiments on the Kidneys of the Frog: F. A. Bainbridge, S. H. Collins, and J. A. Menzies.—(1) The Probable Value to *B. coli* of "Slime" Formation in Soils; (2) Variation in *B. coli*. The Production of Two Permanent Varieties from One Original Strain by Means of Brilliant Green: Cecil Revis.

ROYAL INSTITUTION, at 3.—The Progress of Hittite Studies. II. Religious Monuments of Asia Minor: Prof. J. Garstang.

SOCIETY OF DYERS AND COLOURISTS (London Section), at 8.—The Chemistry of the Vat Dyes: E. de B. Barnett.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Phase Advancing: Dr. G. Kapp.

CONCRETE INSTITUTE, at 7.30.—Discussion on Reports of the Science Standing Committee on: (1) A Standard Notation for Structural Engineering Calculations; (2) A Standard Specification for Reinforced Concrete Work; (3) Standard Connections and Joints in Reinforced Concrete.

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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, APRIL 24, 1913.

CHEMISTRY OF COAL MINING.

(1) *Coal, and the Prevention of Explosions and Fires in Mines.* By Dr. J. Harger. Pp. vii + 183. (Newcastle on-Tyne: Andrew Reid and Co., Ltd.; London: Longmans, Green and Co., 1913.) Price 3*s.* 6*d.* net.

(2) *Safety in Coal Mines: a Text-book of Fundamental Principles for Firemen and other Workers in Mines.* By Prof. D. Burns. Pp. vi + 158. (London: Blackie and Son, Ltd., 1912.) Price 2*s.* 6*d.* net.

(1) IN the first of two papers read respectively on February 27 and October 8, 1912, before the Manchester Geological and Mining Society, Dr. Harger expresses his views regarding a means of preventing the occurrence of explosions as follows:—

"The dry mines in this country are more dangerous than they were several years ago, and are likely to become more so in the future if the Government has its way; . . . a reduction of 1 per cent. in the oxygen content, and the addition of $\frac{1}{2}$ per cent. of carbon dioxide in the ventilating current, is all that is required for most mines; and for the more dangerous mines . . . a reduction of 2 per cent. in the oxygen content and the addition of about $\frac{3}{4}$ to 1 per cent. of carbon dioxide would make the intake airways absolutely safe."

In the second paper Dr. Harger suggests the same means for preventing "gob-fires" (spontaneous combustion). His book is an elaborated edition of both papers, prefaced with some chapters on the nature of coal and its occluded gases, combustion, respiration and the mechanism of explosions.

It is self-evident that if the proportion of oxygen in the air of mines can be reduced in practice to such a point that it cannot support the combustion of either firedamp or coal, neither explosions nor gob-fires could happen. But it is unfortunate that whatever intrinsic value our author's proposals may have—and few would be rash enough at this stage to say they have none—they are based partly upon erroneous impressions regarding the phenomena of great explosions, and partly on the results of what appear to be faulty experiments conducted on too small a scale.

Great explosions do not, as Dr. Harger imagines, travel either exclusively or generally *against* the direction of the ventilating currents; and they do not avoid the working faces or return airways because, as he imagines, the air in these places already contains too little oxygen and too much carbon dioxide to admit of its supporting the combustion of coal-dust.

With regard to the first point, the shot which originated the explosion at Altofts Colliery, to which he refers, was fired in an intake airway at a distance of 550 yards from the bottom of the downcast. The flame traversed all the intake airways but one, at the entrance to which it was arrested by dampness, and in every case (excepting only in the 550 yards) in the *same direction* as the air-currents (Proc. Roy. Soc., vol. xlii., p. 174).[1]

With regard to the second, it was shown (Proc. Roy. Soc., vol. xxviii., p. 416) that return air saturated with, and carrying visible globules of, moisture caught fire at a naked light and burned with a large flame when mixed with a certain coal-dust. That coal-dust came from a colliery adjoining Ferndale, and was of the same quality, so far as volatile matter is concerned, as the *pure* Ferndale dust with which our author failed to get an ignition in his apparatus with normal air. This fact, coupled with the further one that two great explosions have happened at Ferndale colliery—one in 1867 with 178 deaths, the other in 1869 with fifty-three deaths—seems to show that the experiments are not wholly trustworthy, and that some of the conclusions drawn from them as to the quality of air required to prevent ignition will have to be modified.

Dr. Harger proposes to effect his purpose by mixing the necessary proportion of flue gases, which emanate from the boiler furnaces found at every colliery, with the intake air, after having passed them, while still hot, over some catalytic material such as bog iron ore, oxide of copper, finely divided metallic copper, and so on. He contends that if they were thus treated the residual oxygen contained in them would combine with the carbon monoxide, hydrocarbons and smoke, and render them innocuous; and he quotes the authority of Dr. J. S. Haldane and others to show that air of the required quality is not only harmless, but healthful.

His proposals have the distinguishing merit of originality, and have been set forth with such vigorous insistence both in his book and in his papers that they cannot fail to command attention.

(2) This book is designed to meet a want created by the Coal Mines Regulation Act (1911),

[1] Now that this question has assumed some importance it is perhaps rather unfortunate that the Royal Society did not publish the whole of this paper (which is a description of Altofts explosion) as well as the plan of the workings which accompanied it, as some of the misunderstandings and controversies which have arisen during the last twenty-five years might have been thereby avoided.

which provides that, after January 1, 1913, every fireman, examiner, or deputy employed as a fireman, with certain exceptions which need not be here specified, must possess a full certificate stating (1) that he can test for gas with a safety-lamp and is able to see a 2 per cent. "cap," (2) that he can measure an air-current, (3) that his hearing is good.

As a knowledge of the first two requirements cannot be attained by men of this position without tuition, numerous classes have been formed in all the colliery districts for the purpose of instructing them.

Prof. Burns's book is intended to serve as a text-book for these classes, and is, with certain reservations, admirably adapted to its purpose. In attempting to make it suitable to the requirements of both teachers and pupils, however, its author has produced a work which is in some parts too elementary for the former, and in others (indicated by means of asterisks) too abstruse for the latter.

The number of teachers and assistants employed by the education committee of the Glamorgan County Council and the number of candidates who have presented themselves for examination before the same authority during the last eight months are, respectively, eighty-seven and more than 8000. The candidates are thus likely to constitute by far the more numerous class of his readers, and we feel certain that they would much better appreciate the book if those parts of it intended for teachers, together with most of the chemical and other formulæ, descriptions of methods of preparing methane and other gases, and all the more complicated exercises, were omitted. We therefore recommend Prof. Burns, when preparing another edition, to avoid the solecisms which abound in the present book, to eliminate all but the simple matter suitable to the capacity of firemen—which we have no hesitation in pronouncing to be excellent in its present form—and, if he thinks it desirable or necessary, to write another more advanced book for the use of teachers and others.

SOUTH AFRICAN ARCHÆOLOGY.

The Pre-historic Period in South Africa. By J. P. Johnson. Second edition, revised and enlarged. Pp. iv+115+plates+map. (London: Longmans, Green and Co., 1912.) Price 10*s*.

IT is satisfactory to find that there is a sufficient interest in the subject of South African archæology to require a second edition of Mr. J. P. Johnson's book on "The Pre-historic Period in South Africa" within two years. In the new edition some new finds are referred to, and there is an appendix by Mr. A. S. Kennard on the sequence of the stone implements in the Lower Thames Valley. Mr. Johnson describes and figures chipped stones from Leijfontein, below the Campbell Rand, which closely resemble those from the plateau of Kent, and he does not hesitate to call them "eoliths." Implements of river-drift types are distributed all over South Africa. "Among the amygdaliths [his term for the common type of implement] every gradation is met with between the thick Chelléen form with unworked butt, the thinner Acheuléen type with edge carried all round, and the proto-Solutréen form pointed at both ends"; he calls them all "Acheulic." He also recognises "Solutric" implements; amongst these are "pigmy implements" of chert. Dr. Péringuey found implements at Bloemsbosch in what Johnson considers a Solutric site, apparently contemporary with a large extinct buffalo and horse. In the present state of our knowledge it is rather begging the question to apply without qualification to South African finds the terms used to designate special "industries" of European archæology. It would be a wiser plan to use non-committal designations while pointing out the similarities in the forms of the implements.

The Coast middens described by Dr. Péringuey are referred to, and several excellent reproductions are given of petroglyphs and rock-paintings, the peckings made by the Bantu being markedly inferior to Bushman work. The upper drawing of his Fig. 37 is of a rock-painting described by G. W. Stow in "The Native Races of South Africa" (p. 121). Mr. Johnson has no doubt that the "Solutric" implements were made by the ancestors of the present Bushmen, who, he believes, were very far from being a homogeneous people. Prof. Sollas, in "Ancient Hunters and their Modern Representatives," regards it as highly probable that in Aurignacian times a race allied to the Bushmen inhabited western Europe (p. 268). Mr. Johnson, however, seems to class the Aurignacian, Solutrian, and Magdalenian stages under the term Solutric. Support is given to the view that the famous forts or kraals and other ruined structures in Rhodesia were built by prehistoric Bantu in connection mainly with gold-mining, and he supplies plans of four stone-walled ruined kraals at Ramoo Kop for comparison with those already published.

ASPECTS OF THE EARTH.

(1) *Lehrbuch der Grundwasser- und Quellenkunde.* Für Geologen, Hydrologen, Bohrunternehmer, Brunnenbauer, Bergleute, Bauingenieure und Hygieniker. By Prof. K. Keilhack. Pp. xi + 545. (Berlin: Gebrüder Borntraeger, 1912.) Price 20 marks.

(2) *The Geology of Soils and Substrata.* With Special Reference to Agriculture, Estates, and Sanitation. By H. B. Woodward. Pp. xvi + 366. (London: E. Arnold, 1912.) Price 7*s.* 6*d.* net.

(3) *Die erklärende Beschreibung der Landformen.* By Prof. W. M. Davis. Deutsch bearbeitet von Dr. A. Rühl. Pp. xviii + 565. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 11 marks.

(1) PROF. KEILHACK has produced a book on water-supply which presents a remarkable contrast with the brief treatment of the subject in many works on engineering. Yet he regards these five hundred tall and handsome pages as constituting a preliminary "Lehrbuch," leading up to a future "Handbuch" of Teutonic magnitude. The geologist here subordinates himself willingly to his technical purpose. The kinds of rocks are dealt with in a few short sentences, but their structure and the passage-ways for water in them are at once impressed upon the reader as of paramount importance. The characters of soils as water-bearers receive rather slight attention, and the necessity for discriminating between the "fine earth" used experimentally and the soil as part of the earth's crust, with all the stones in it, seems left to the intelligence of the reader.

In all questions involving maps Prof. Keilhack is on ground that is specially his own, and he makes good use of the beautiful products of the Prussian Geological Survey. The discussion of the form of the surface of the subterranean water-table is unusually detailed. The problems of the European karstlands are considered; but the author probably leaves for his still larger treatise the interesting feature of water-supply in more arid countries, such as rivers disappearing into sandy wastes, the origins of oases, and the salts deposited in the surface-zone of excessive evaporation. Prof. Keilhack's book is an excellent example of the application of scientific research, wide and without ulterior motive, to the stimulating needs of human enterprise.

(2) Mr. H. B. Woodward's latest addition to Arnold's Geological Series is an attempt to look at soils from a geological point of view, and at the strata below them from the attitude of an agriculturist. The proper treatment of the soil is rapidly becoming a matter for the organic chemist and the biologist, but the foundation on which the soil-activities are based is an aggregate of mineral particles spaced in very various ways. The soil-forming minerals are rather briefly treated on pp. 55–6, and the calcium fluoride and chloride of apatite have somehow got attached to dolomite. The beneficial character of some of these minerals and the deadly effect of others are not indicated at this stage; but we find a good deal of diffused information when we reach the accounts of soils formed on various types of rock. The vexed question of what is "clay" is left alone, but we may hesitate to accept the statement (p. 78) that the Kimeridge, Gault, and London Clays contain "up to 95 per cent. clay." The remark on p. 73 that "alumina, in the form of silicate of aluminia or clay," absorbs and retains moisture and serves as a binding material does little to help us towards understanding the rock known as clay. Analyses of the clays mentioned above, moreover, are given on p. 59, and show at the most 50 per cent. of aluminium silicate.

If we feel that the first part of the book does not quite realise the author's aim, and does not explain the soils and their structures to an agriculturist as a geologist might explain a landscape to a painter, the latter section will convey much special information to landowners in the British Isles. The soils on the subdivisions of our stratified series are described by one who knows their aspect well, and these chapters form a general account of the superficial deposits of England, with many useful notes on those of Scotland and of Ireland.

(3) Prof. W. M. Davis has always a question to ask which must be answered in the field itself. At times he may seem to ignore the mineral details which lie at the root of rock-structure, and therefore at the root of the features produced during a cycle of erosion. But he rightly, on p. vii. of the present work, distinguishes between geological and geographical description; in the latter, all attention must be concentrated on the surface-forms as they are to-day. The lectures delivered in German by Prof. Davis in 1908–9 at the University of Berlin are here presented, with the assistance of Dr. Rühl, as a general treatise on land-forms. They are illustrated by the author's line-drawings, minute and thoughtful, like the work of Albrecht Dürer, and sometimes presenting, as the earth does, too many problems in the limits of a single scene.

Anyone who examines these drawings will be made to understand features that he remembers viewing casually, perhaps even from a railway train; and now for the first time he perceives them in their true relations. The dissected highland of fig. 116, with the broad cone of detritus forming the only habitable region at its foot, will remind the traveller of the valley of the Inn or of the Drau. The volcanic relics in fig. 132 explain Gergovia and Mont Dore. The eighth chapter, on "Der aride Zyklus," appeals strongly to pioneers on the edges of our colonised lands, and would have edified the Roman senate, when it republished the Carthaginian text-books and faced the problems of the desert and the steppes. On pp. 375–6 the evidence for a recent uplift of central and southern Africa is well stated. A characteristic discussion on the methods of presenting geographical problems finds its way somehow into this chapter. British geologists will turn with interest to the chapters on glacial conditions and marine erosion. The explanation of the features of the coast of south Devon on p. 502, which seems at first somewhat complex, is fully justified when we realise that the "soft rocks" postulated really exist in the form of Cretaceous and perhaps Eocene limestones beneath the English Channel.

The disguise of Prof. Davis as a Prussian is a thin one. Who does not recognise him in the brilliant description of the Roman area on pp. 393–4, which is to occupy four minutes of oral instruction; or in the terrifying discovery on p. 398 that every land-form can be treated geographically in four-and-fifty different ways?

Grenville A. J. Cole.

OUR BOOKSHELF.

The Manufacture of Iron and Steel: a Handbook for Engineering Students, Merchants, and Users of Iron and Steel. By H. R. Hearson. Pp. xi + 103. (London: E. and F. N. Spon, Ltd., 1912.) Price 4*s.* 6*d.* net.

This small volume is obviously primarily intended to give engineering students an outline of the manufacturing operations of iron and steel, and also an idea of the chemical characteristics and the mechanical properties of the finished products. The author has undoubtedly, to a great extent, produced a lucid and useful little text-book.

After a preliminary chapter on elements, the blast furnace is considered, being followed by a short chapter on wrought iron. Steel is next dealt with, including the Bessemer, Crucible, and Siemens methods. The book has so much valuable and accurate information that it may be of very great use to elementary students of iron and steel metallurgy, but several remarkable errors should be revised in any future edition. For instance, on page 37, steel containing 0·3 per cent. of carbon is classified as medium instead of mild, and steel containing 0·7 per cent. of carbon is designated hard instead of medium. In describing the manufacture of "blister steel" by cementation, the author states, "None of the bars is carburised right through to the centre, so the centre still remains as iron." This is true of, say, No. 2 bars, but high-number bars are always "steel through." Some of the paragraphs on crucible steel also need serious revision; for instance, the curious assertion that if kept too long in the furnace the steel will become brittle by taking up too much silicon from the crucible. Mr. Hearson also revives the obsolete dictum that mild steel is crystalline and wrought iron fibrous. On page 77 the somewhat astounding information is given that the top of an ingot may be prevented from rapidly solidifying by covering the top with sand. The chapter on the mechanical testing of steel is excellent, but in the brief final chapter dealing with the heat treatment of steel many metallurgists will be surprised to learn that steel containing 0·25 per cent. of carbon becomes "hard" on quenching, and the paragraphs on hardening are out of date. If carefully revised, however, the book will become of distinct value.

J. O. A.

Photochemische Versuchstechnik. By Dr. Johannes Plotnikow. Pp. xv + 371. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1912.) Price 11 marks.

This book forms the complement of a previous volume by Dr. Plotnikow on the theory of photochemistry ("Photochemie," W. Knapp in Halle a.S., 1910). In the present work he describes at length the apparatus and the experimental methods used in photochemical research. Part i. contains a useful summary of the characteristics of the various sources of light that may be employed. The mercury arc lamp, in which a steady electric current is passed through the vapour of mercury in a highly exhausted tube of Uviol glass or of fused quartz, is recommended as providing a constant and trustworthy source. Other sources discussed are the arc and spark between metal terminals, the carbon arc, the Nernst lamp, and the Röntgen ray tube. In part ii. Dr. Plotnikow describes the construction of the special forms of thermostat which he has devised for photochemical experiments, and enumerates a number of solutions that may be employed as light filters with the mercury vapour lamp in order to give approximately monochromatic light.

Part iii. contains an account of the instruments used in optical measurements, including photometers, spectrophotometers, spectrometers, refractometers, and polarimeters.

In part iv. the author describes a number of interesting lecture experiments for illustrating the fundamental laws of photochemical reactions, the various phenomena of luminescence, and the principal facts of photoelectricity. It is satisfactory to find attention directed to the subject last named, since the separation of negative electrons under the influence of light probably forms the clue to the understanding of the mechanism of all photochemical processes.

Part v. contains a collection of tables likely to be useful in photochemical work. The values of the function e^{-x} are tabulated in thirteen pages from $x=o$ to $x=10$, and fifty-six pages are assigned to tables by Dr. N. Rosanow showing the reciprocal of the wave length and the frequency for every Ångström unit from λ 2000 to λ 8000. H. S. A.

The Economics of Everyday Life. Part i. By T. H. Penson. Pp. xiv+174. (Cambridge University Press, 1913.) Price 3s. net.

It is surprising how difficult it apparently is to write a good short text-book of economics, but Mr. Penson has been eminently successful in doing so. He has fully grasped the fact that the first need for such a book is to be simple and elementary as well as short. Where possible, he rightly prefers the ordinary terms of everyday use to the technical phrases of economics. For instance, instead of production, exchange and distribution, he talks of the "source of income," "buying and selling," and the "individual income." These, in my opinion, are far more intelligible to the beginner. Moreover, his definitions are nearly always both clear and adequate, those of demand and supply affording a good example.

The method of treatment follows, on the whole, that of the modern school, of which Prof. Marshall may be regarded as the head, and exchange is treated before, and not after, distribution. The subjects of consumption, taxation, trade unions and cooperative societies are left to the second part of this book, which has yet to be published.

The present volume clearly marks Mr. Penson as possessing great capacity as a teacher. He chooses wisely not only his terms, but the subjects of which he treats. Omitting nothing that is essential, he has avoided thorny and difficult subjects likely to confuse the beginner. His definitions, too, are both concise and complete. A new and valuable feature of the book is found in the simple tables and diagrams by which the argument is rendered easy to understand, but mathematical methods are rigidly, and in such a book rightly, avoided. Occasionally, however, the author treats unimportant matters somewhat too fully. Usually he is neither too long nor too short, but, like Sidney Godolphin, "is never in the way, and never out of it." N. B. Dearle.

Dent's Practical Notebooks of Regional Geography. By H. Piggott and R. J. Finch. Book i., The Americas. Pp. 64. (London: J. M. Dent and Sons, Ltd., 1913.) Price 6d. net.

If every geography teacher set the same practical exercises, this conveniently arranged notebook would have a wide circulation; but naturally a teacher's exercises should reflect his own individuality. The little book may be commended, however, as affording a good example of the way in which pupils can be led to acquire an intelligent knowledge of geography as the result of their own activities.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

An Application of Mathematics to Law.

I have attempted to apply mathematical symbolism to some of the difficult problems of patent law. The question to be decided by the Court in a patent law suit is usually this: assuming that the alleged invention deals with "a manner of manufacture" (*i.e.* is, or yields, something concrete), was there ingenuity and utility in the step from what was already known? Ingenuity means inventive or creative ingenuity as apart from the normal dexterity of the craftsman, which of itself is insufficient to support a patent, as otherwise patents would unduly hamper industry. It will be seen at once that it is a most subtle question for any court to determine whether a given act, the selection of one out of many alternatives, the assemblage of various old elements, the adaptation of old elements to new uses—whether such an act is one which calls for ingenuity as apart from the expected skill of the craftsman.

To express the problem symbolically I will start from an admirable dictum of Lord Justice Fletcher Moulton (Hickton Pat. Syn. *v.* Patents Improvements). He stated that invention might reside in the idea, or in the way of carrying it out, or in both; but if there was invention in the idea plus the way of carrying it out, then there was good subject-matter for a patent. I express this by representing any idea as a functional operator, and the way of carrying it out (*i.e.* the concrete materials adopted) as a variable. Calling result I:

$$I=f(x).$$

Here I represents what the Germans call the "technical effect" of the invention, or what Frost calls the manufacturing "art," and we see at once that a patent cannot be obtained for a mere principle or idea (f, which is not concrete) unless some way of carrying it out (x) is also given. But the invention may reside either in f or in x.

Let us express in general terms a manufacture (M) which is not an invention. We will use f to represent a known operator or idea, ϕ to represent a new operator or idea. a, b . . . will represent known variables, ways of carrying out an invention (*e.g.*, valves, chemical substances, &c.), and x, y, new variables.

It is obvious that $f(a)$ is not an invention, nor will it normally be an invention to add $f(b)$ to it. Moreover, the craftsman is not to be tied down to this. He is at perfect liberty, within limits, to make variations in his variables, to alter the size of a crank, to substitute one alkali for another, and so on; in other words, he can take $f(a+\delta a)$.

Generalising, we may say:

$$M=\Sigma f(a+\delta a).$$

Developing this by Taylor's theorem, and proceeding from an infinitesimal to a finite change, we have, neglecting quantities of the second order:

$$M=\Sigma f(a)+\Sigma\delta f(a).$$

This is the general equation for a manufacture which is not an invention. To be an invention, ingenuity (i) must be involved.

$$I=M+i \text{ or } I=\psi(M),$$

thus:

$$I=\psi[\Sigma f(a)+\Sigma\delta f(a)]=\Sigma f(a)+\Sigma\delta f(a)+i.$$

I will now consider in various actual examples the nature of ψ, the inventive function, and of i, the inventive increment.

One of the commonest cases in which a decision is necessary is that of a combination. Suppose that $f(a)$ and $f(b)$ are old; will there be invention in combining a and b?

The answer is this:

$$(1)\ I=f(a, b)$$
$$(2)\ M=f(a)+f(b)$$
$$(3)\ I=M+i.$$

If the result of the combination is given by (1), there is an invention; this is termed a "combination." If the result is given by (2), there is no invention; this is termed an "aggregation." It is interesting to compare this definition with one given by Lord Justice Buckley (Brit. United Shoe Mach. Co. *v.* Fussell) of a "combination" as "a collocation of intercommunicating parts, with a view to obtaining a simple result."

An example of a true "combination" is found in the case of Cannington *v.* Nuttall, in which a patent was upheld for a glass furnace, although each and every part (a, b, c) had been employed before in glass furnaces (employment$=f$). But, owing to the combination, and the co-operation of the parts, a new result was obtained.

$$I=f(a, b, c)=f(a)+f(b)+f(c)+i.$$

On the other hand Bridge's case is an example of an aggregation; in fact, a patent was refused by the Law Officer, showing that the case was considered absolutely devoid of invention. The alleged invention consisted in the employment in a shutter for dividing-up rooms (f) of means (a) to guide the shutters along the floor, and cogs (b) to hold the shutters against the wall. $f(a)$ and $f(b)$ were both old, and no new result flowed from their juxtaposition. Hence $M=f(a)+f(b)$: there was no invention; each part simply played its own rôle, and there was no interaction.

Another type of invention is that of varying proportions in a known combination. Here, if $M=f(a, b, c)$, and if there is a maximum at one value or range of values of c, invention may be involved. The maximum relates to the technical effect, and may be with respect to efficiency, economy, &c.

Thus if $\frac{\partial f(a, b, c_1)}{\partial c}=0$ at the value c_1, the function will be a maximum or a minimum and there may be an invention. This will not be the case if $\frac{\partial f(a, b, c_1)}{\partial c}\neq 0$.

Other singular points may be inventions, *e.g.* where $\frac{\partial f(a, b, c_1)}{\partial c}=\infty$ (discontinuity), or where $\frac{\partial^2 f(a, b, c_1)}{\partial c^2}=\infty$ (kink in the curve). This also holds for a range of values from c_1 to c_2.

Examples of the application of this equation are to be found in the cases of Edison *v.* Woodhouse, and Jandus Arc Lamp Co. *v.* Arc Lamp Co. In Edison's case f represented the employment in an incandescent lamp of an exhausted glass vessel (a), leading-in wires (b), and a carbon filament (c_1). $f(a, b, c)$ was known, but it had never been proposed to use a very thin carbon conductor or "filament." Here, owing to the high resistance and flexibility of the filament, the efficiency was a maximum:—

$\frac{\partial f(a, b, c_1)}{\partial c}=0$, and the choice of this value c_1, which made the difference between failure and success, was held to be an invention.

In the Jandus Arc Lamp case, f represented the employment in an arc lamp of carbons (a), a tightly fitting sleeve (b), and an envelope of glass, &c. (c), inside the outer globe. By making the glass envelope 3 in. in diameter a maximum efficiency was obtained, and on this ground the patent was upheld, although envelopes had previously been made 9 in. in diameter. Here again:

$$\frac{\partial f(a, b, c_1)}{\partial c}=0 \text{ when } c_1=3 \text{ in.}$$

A further example is an old case (Muntz *v.* Foster) in which a sheathing for ships was made of sixty parts of copper (a) and forty of zinc (b).

Alloys of copper and zinc had been used before in about the same proportions, but in this case the same result would not have been attained, because Muntz specified the best selected copper and highly purified zinc. The impurities (δx) were of great and unsuspected importance. Moreover, other alloys of copper and zinc (probably even of purified metals) had been made. We may consider the two points separately.

(1) Impurities:—

$f(a+\delta x, b+\delta x)$ was old, where δx represents impurities. Muntz's alloy was $f(a, b)=f(a+\delta x, b+\delta x)+i$, hence there was an invention.

(2) Selection of 60 : 40 percentage:—

$\frac{\partial f(a_{60}, b_{40})}{\partial a}=0$ since at this percentage the efficiency was a maximum, because the alloy oxidised just fast enough to prevent barnacles adhering to the ship, but not fast enough to waste away excessively.

On the contrary, the case of Savage *v.* Harris was one in which there was held to be no invention in changing the size of part of a device for retaining ladies' hats in place. There was a back portion (a) and teeth (b), and the size of the back was altered:—

$\frac{\partial f(a_1, b)}{\partial a}\neq 0$, and there was no invention.

A known device or material (a) may be employed for a new purpose (ϕ). If $f(a)$ is the old use, and $\phi(a)$ the new use, we have for an invention $I=\phi(a)=f(a)+i$. But if $M=\phi(a)=f(a)$, there is no invention. The oft-quoted case of Harwood *v.* Great Northern Railway Company was one of the latter type. Fishplates (a) had been used for connecting (f) logs of timber, and it was held there was no invention in applying them (ϕ) to rails in which they acted in the same manner:—

$$\phi(a)=f(a).$$

But in Penn *v.* Bibby, wood (a) was employed (ϕ) for the bearings of propellers in order to allow the water to pass round the friction surfaces. Wood had previously been employed (f) in water-wheels, but $\phi(a)=f(a)+i$, and it was held that there was invention.

A similar type of invention is that in which different materials are employed in the same process. Here $f(a)$ is old, and $f(x)$ is new. If $f(x)=f(a)$ there is no invention. If $f(x)=f(a)+i$ there is invention. In the recent case, Osram Lamp Works *v.* Z Lamp Works, a patent was upheld for the use (f) in incandescent filament lamps of tungsten (x), though osmium (a) was known. Tungsten was more efficient and cheaper:—

$f(x)=f(a)+\delta i$, where δi represents a small degree of invention. This in itself might not have been sufficient, but it was coupled with the fact that one particular process of removing the carbon from the filaments was selected out of three known processes. This may be considered to require an amount of ingenuity Δi. $\delta i+\Delta i=i$, and therefore $f(x)=f(a)+i$, and there is invention involved.

Another type is the omission of one step in a known process. In the case of Badische Anilin- und Soda-Fabrik *v.* Soc. Chim. des Usines du Rhône, it was held that there was subject-matter in such an omission. A process had been proposed for preparing dyes called anisolines (A) from rhodamines (r) by first forming a potassium salt (1st step$=f$), and then transforming this salt into anisoline (2nd step$=$F). Thus the known process was:—

$$A=F[f(r)].$$

Now it was shown that the potassium salt did not exist, *i.e.* $f(r)$ was imaginary; the patent in question obtained anisoline direct from rhodamine, $A=f(r)$, and this was held to be an invention.

I may note two final points. When a patent is granted, the criterion of ingenuity is not applied, as this is left for the Court to determine. However, if there is absolutely no ingenuity possible, the Law Officer may refuse to grant a patent. His criterion of rejection is, therefore, not $f(x)=f(a)$, as in the Court, but $f(x)\equiv f(a)$.

A patent is invalid for "insufficiency of description" if it casts on the public the burden of experiment beyond a certain point. This may be expressed by saying that in this case the equation $I=\phi(a)$ is indeterminate. HAROLD E. POTTS.

University Club, Liverpool, April 2.

A University in the Tropics.

THE importance and value of the establishment of a university in the tropics can only be appreciated fully by those who, trained in the universities of Europe, are suddenly brought face to face with the unfamiliar conditions obtaining in a tropical country. That the proposition may be thoroughly considered and eventually realised must be the wish of all interested in the development of our tropical possessions.

The question of a site for an imperial tropical university is one upon which divergent views may be expected; few men know the equatorial belt with uniform intimacy, and are liable in consequence to be prejudiced in favour of one part or another. Admitting my own imperfect knowledge, I would like to bring forward the claims of British East Africa as an eminently suitable situation for such a university.

Dissected by the equator, it cannot be equalled for position in British territory. Rising from sea-level to plateaus more than 8000 ft. in altitude, with a mountain rising more than 17,000 ft., far above the snow-line; with heavy rainfall in one part and almost rainless deserts in another; with healthy districts and parts uninhabitable by man in consequence of deadly disease; with soils varying from coral through sands to loams and clays; with standard crops from cocoanuts, rubber, and cotton, to coffee, maize, and wheat; with a large native population possessing many different languages and customs; with a flora and fauna as diversified as climate and altitude, and probably as varied as is to be found in any country; with a geological structure presenting some of the most interesting features in the world—British East Africa, the only British territory through which the equator passes, is surely uniquely situated for the seat of an imperial tropical university for the study and advancement of our knowledge of medical, agricultural, botanical, zoological, anthropological, ethnological, and other branches of science.

The capital of the country, Nairobi, is situate within 100 miles of the equator, is in a healthy district, is twenty-four hours by rail from the coast tropical belt, and the same distance from the Victoria Nyanza and Uganda, both full of the most diverse subjects of scientific interest.

The proximity of India is another great advantage in this respect. Practically all the natural conditions obtaining there—even acquaintance with the natives and their languages—may here be studied while residing in a climate resembling an English summer.

If any more suitable position for an imperial tropical university can be found than Nairobi, then the British Empire is indeed most fortunate, but a glance at the map does not suggest the possibility of such a collection of favourable factors occurring elsewhere. The passage is seventeen days, with choice of five steamship lines. U. H. KIRKHAM.

Government Laboratory, Nairobi, February 24.

The Twinkling of Stars.

IN three papers in *The Journal of Physiology* I have described a number of new visual phenomena which show that the photochemical stimulus is situated externally to the cones, and that the foveal region is sensitised from the periphery of the retina. The result of this is that at one moment the foveal region may be the most sensitive part of the whole retina, and at another blind. The twinkling of stars may be imitated in the dark-room. If a small light be looked at in a dark-room, as, for instance, that coming through the smallest diaphragm of my colour perception lantern, which represents a 5½ in. bull's-eye railway light at a thousand yards when seen at a distance of 20 ft., care being taken not to move the eye, the light will appear to twinkle like a star. It will be noticed that pale bluish-violet circles start at the periphery of the field of vision, and, gradually contracting, reach the centre. On reaching the centre the light brightens. If the circles stop the light disappears. The colour of the circle is the same for white light or any colour.

There is another simple experiment which shows how the centre of the retina is sensitised from the periphery. On opening one eye on awaking in the morning and looking at the ceiling, the central portion is seen as an irregular, circular, rhomboidal, or star-shaped black spot. On closing the eye again a bluish-violet circle appears at the periphery or middle of the field of vision, contracts, and then, after breaking up into a star-shaped figure and becoming brighter, disappears, to be followed by another contracting circle. If the eye be opened when the star figure has formed in the centre it will appear as a bright rose-coloured star much brighter than any other part of the field of vision. If, however, we wait until the star has broken up and disappeared before opening the eye, it will be found that only a black spot is seen in the centre. F. W. EDRIDGE-GREEN.

London, April 14.

Gain of Definition obtained by Moving a Telescope.

A SLIGHT adaptation of the explanation offered by your correspondent Mr. G. W. Butler (April 10, p. 137) appears to furnish a more natural solution of the problem. When an object at rest is seen against a background which it closely resembles there is nothing to differentiate between the object and the slight irregularities of the background. So soon as the object moves, such a differentiation becomes possible, the moving irregularities being now attributed to their real origin. It seems unnecessary to assume a "cumulative impression of contrast."

The following simple experiment lends support to this explanation. A small opening is cut in a sheet of paper covered with irregular markings, such as ink dots. Against the back of this is held another sheet similarly marked. If now the sheets are observed from such a distance that the edges of the opening are invisible, its position cannot be determined except by sliding one sheet over the other, when the motion of some of the dots with respect to the others immediately betrays its situation. R. S. CAPON.

Oxford.

MR. M. E. J. GHEURY concludes a note in the issue of NATURE of March 27, relating to the gain of definition obtained by moving a telescope, with the words: "Perhaps some of your readers have noticed something similar and could throw a little light on this mysterious phenomenon."

By a curious coincidence "something similar" did come to my notice just one day previous to my reading of Mr. Gheury's note. I do not propose to throw any light on the question, nor do I wish to imply that there is anything more than an accidental and external similarity between the two cases in question. But it may not be out of place to direct attention to a peculiar observation recorded in *The Mechanic's Magazine* of the year 1829, and rescued from oblivion in a recent number of the German periodical *Prometheus*. The experiment is extremely simple, and can be repeated by anyone with the very simplest materials.

Take a piece of paper of such thickness that when it is laid over a sheet of printed matter the characters just show through but cannot be read. Place this over a page of printed characters, move it about with a circular motion, and you will no doubt be surprised to find that now the print shows through and can be read with comparative ease. It is, of course, necessary to adjust the thickness of the paper and the size of the type, but two or three trials are sufficient to determine the right conditions for the experiment.

ALFRED J. LOTKA.

New York, April 11.

THE NEW SEISMOLOGY.

FOR very many years past in Italy, and to a lesser extent in other countries, earthquakes had been recorded, while a few private individuals collected and analysed earthquake statistics. These, however, were the days of seismoscopes and the old seismology. The new seismology did not come until macroseisms had been measured and teleseisms had been discovered. With their arrival new lines of physical, and particularly geophysical, research were opened for exploitation. Commencing in Japan, the desire to record and discuss the felt and unfelt palpitations of our earth spread like an epidemic round the world. In 1880 the Seismological Society of that country was founded, and the twenty volumes which it issued contain initiatives for very many of the investigations carried out since that date. When this society ceased to exist the Japanese Government established an Earthquake Investigation Committee, which up to date has published more than eighty quarto volumes.

In the early days attention was first directed towards obtaining instruments which would give actual measurements of earthquake motion. Steady-point instruments were devised, and, for earthquakes we feel, are now in use throughout the world. From a knowledge of the actual nature of earthquake motion derived from these instruments, new rules and formulæ for the use of engineers and builders were established. To test the suggested new departures in building and engineering practice, structures in brick and other materials were fixed upon platforms actuated by powerful machinery and subjected to movements closely corresponding to those of heavy earthquakes. The results of these investigations in Japan and other countries have been extensively applied in the construction of piers for bridges, tall chimneys, walls, ordinary dwellings, embankments, reservoirs, &c. Inasmuch as the new types of structure have for very many years withstood violent shakings, while ordinary types in their neighbourhood have failed, it may be inferred that much has already been accomplished to minimise the loss of life and property.

The application of seismology to the working of railways, particularly in Japan, led to the localisation of faults on lines, and alterations in the balancing of locomotives. The result of the latter has been to decrease the consumption of fuel.

Later, instruments were devised to record earthquake motion which cannot be felt, with the result that a person living in any one part of the world can record and obtain definite information about any *large* earthquake originating even so far off as his antipodes. These records of the unfelt movements of earthquakes have from time to time indicated the position, the time of occurrence, and, what is of more importance, also the cause of certain cable interruptions. The practical importance of this latter information, especially to communities which may by cable failures be suddenly isolated from the rest of the world, is evident.

The many occasions on which earthquake records have furnished definite information respecting disasters which have taken place in distant countries, corrected and extended telegraphic reports relating to the same, is another illustration of the practical utility of seismic observations. Seismograms have frequently apprised us of sea waves and violent earthquakes in districts from which it is impossible to receive telegrams, while the absence of such records has frequently indicated that information in newspapers has been without foundation or at least exaggerated. Localisation of the origin of these world-shaking earthquakes, besides indicating sub-oceanic sites of geological activity, indicates positions where the hydrographer may expect to find unusual depths. They have also shown routes to be avoided by those who lay cables.

Seismograms of unfelt movements throw light upon what have but recently been regarded as unaccountable deflections in the photograms from magnetographs, barographs and other instruments sensible to slight displacements. They have also explained unusual rates in certain timekeepers.

Among the very many scientific results which the new seismology has contributed to science is that it has given us the velocities at which motion is propagated in various directions through the world. Until these observations had been made our knowledge respecting the interior of the earth chiefly related to its density and temperature. Now we know much respecting its rigidity.

With the object of increasing our knowledge of teleseismic disturbances, in 1896 the British Association, with the assistance of the British Government, communicated with many foreign States and Colonies suggesting that they should establish a certain type of seismograph. The result has been that the British Association now enjoys the cooperation of fifty-nine similarly equipped stations which are fairly evenly distributed over the world. The general outcome from this and the work carried out in Japan is that nearly every civilised country in the world has had its attention directed to this new departure in geophysics and has established seismographs.

In the last-mentioned country observers are to be found in most towns, and many instruments have been installed to record macroseisms and teleseisms. The annual outlay for earthquake work in that country is about 5000*l.* Russia, for the support of a system extending over its vast territories, expends a similar amount. Italy, which is the oldest country for recording earthquake phenomena, is covered with stations. Austria, France, Switzerland, Chile, the United States of America, the Balkan States and the small States of Central America each have their organised systems, while in Germany we find the headquarters of the International Seismological Association. This is supported by yearly contributions of about 1600*l.* from twenty-two countries. The headquarters of this body is in Strassburg, but it also controls stations in Beirut and Reykjavik. In Great Britain teleseisms are now recorded in thirteen different places. Three of these stations are owned by private persons, but the one in the Isle of Wight is largely supported by grants from the Royal Society, the British Association and Mr. M. H. Gray. The remaining nine are attached to existing observatories or other institutions.

J. Milne.

THE PROBLEM OF TUBERCULOSIS.

The final report of the Departmental Committee on Tuberculosis was recently published. Since the interim report of 1912 (April) was issued the committee has been engaged in devising methods for dealing with the general problem of tuberculosis as it affects the community. This introduces at once the difficulty as to the policy to be followed with those cases occurring among the non-assured under the National Insurance Act. The funds for this purpose are now promised by the Government up to one half of the estimated cost, and whilst giving the ratepayers control of the local administration the funds mentioned are to be drawn from national sources.

Dr. Newsholme has shown how largely the improvement recorded in respect of this disease is really due, not so much to successful treatment, but more to the segregation of the advanced cases in special institutions, chief among these being those wards of the Poor Law infirmaries set apart as sanatoria. But the law has till now left (and still leaves) the patient the right to "claim his discharge" when he pleases, and this is frequently exercised to his own detriment; but the committee now realises that, in addition, he is a source of danger to others in his environment. On this ground it is proposed to withdraw this liberty from the class of infective "ins and outs." It is a noteworthy point that the tuberculosis of children is now accepted by the committee as mainly of bovine origin.

The outstanding feature of the report is that of the provision for research, and its recognition in a fuller sense than has yet found its way to the statute book. The committee computes that an income for this purpose will accrue under the Insurance Act of about 57,000*l.* a year, and it proposes the establishment of various grades of research workers, to include the appointment of full-time men, who shall entirely devote themselves to research "at an adequate salary," with a subsequent pension.

The outline of a detailed scheme is given which includes the use of existing agencies, but contemplates also the formation of a central bureau with an expert secretary director at the head. This is primarily designed for the reduction of statistics to comparable form, and may comprise a research institution as well.

In view of the scattered distribution of the workers some such arrangement is clearly necessary; and, further, the committee indicates the need, in its opinion, of keeping the workers in touch with the work done abroad.

The creation of scholarships is recommended, but a department of foreign inquiry, either by scholarship or commission, would enhance the knowledge of the whole body, and prove a constant stimulus to the highest effort.

A point of considerable importance is raised by the reference to laboratory facilities. "Access" to these by various local centres of work must always give way in effectiveness to work done by small equipments for diagnosis at these centres. The Commissioners consider that not merely tuberculosis, but any disease from which the assured may suffer may come under similar review.

On taking the figures from the 1909 census report, tuberculosis claims 10·5 per cent. of all causes of mortality, and that of the "respiratory" group following—pneumonia and bronchitis—it will be noted that thus combined this figure exceeds the former. It must not be forgotten, however, that the latter includes cases of non-diagnosed tubercle, and others the essential feature of which is old age.

Tuberculosis, therefore, would claim the fullest, if not the sole, attention at first. This is confirmed by the figures just to hand of the results of the first year's working of the compulsory notification of infective diseases, including tubercle. Tuberculosis heads the list with 110,551 cases, which amount to 3·06 per 1000 population. The next return is scarlet fever, 2·98 per 1000. This takes no account of the difference in mortality or disability entailed by these two diseases, and if allowed for would greatly raise the former.

The committee is to be congratulated upon an earnest attempt to deal constructively with a complex question. Its tendency throughout to ignore the medical department of the Local Government Board will doubtless be rectified later in the interests of unified public health administration.

NOTES.

The Secretary of State for the Colonies has appointed a Commission to study the nature and the relative frequency of the fevers occurring amongst the Europeans, natives, and others in West Africa, especially with regard to yellow fever and its minor manifestations. The members of the Commission are:—Sir James K. Fowler, K.C.V.O. (chairman), Major Sir Ronald Ross, K.C.B., F.R.S., Colonel Sir William Leishman, F.R.S., Prof. W. J. R. Simpson, C.M.G. Mr. A. Fiddian, of the Colonial Office, has been appointed secretary to the Commission, and Mr. T. F. G. Mayer assistant secretary. In the absence of special reasons, the members of the Commission will not themselves proceed to West Africa, but local investigators will work under their direction at certain centres. As at present arranged, those centres will be Freetown in Sierra Leone and Sekondi and Accra on the Gold Coast. The investigation will be set on foot towards the end of April or early in May. Endeavours have been made to enlist the cooperation of all medical men practising in the British dependencies in West Africa, whether as Government medical officers or otherwise. The funds for this investigation will be provided by the West African dependencies.

M. Jules de Payer has furnished the Paris correspondent of *The Pall Mall Gazette* with particulars of his projected arctic expedition, which is intended to leave France in the summer. With the support of the Government and various societies, he will follow his father, the distinguished explorer, in making for Franz Josef Land. One of his objects is to locate the margin of the polar basin to the north-east of that archipelago, an investigation which, if successfully carried out, will provide data for an estimate of the relative areas of the basin and the continental shelf in that quarter of the arctic region. A scientific staff will accompany M. de Payer, with equipment for the prosecution of research in all the various departments which have become associated with polar work; among them the investigation of the upper atmosphere by means of kites is specially indicated. The party will be provided for a sojourn of one year or longer in the north, its ship returning in the meantime. It is to be provided with two aëroplanes, the utility of which as instruments in polar research will be observed with interest: a visit to the pole itself is mentioned as a possibility, but does not appear as a prime object of the expedition. Wireless telegraphy will be installed at the headquarters.

All who had the pleasure of the acquaintance of Mr. Carl Hagenbeck—whose death occurred at Hamburg on April 15—could not fail to recognise the indomitable will and dogged perseverance of the man, coupled as they were with a manner of unusual gentleness and kindliness. It was no doubt owing to this unusual combination that Hagenbeck was so signally successful in his trade, for by the former traits he carried out in the most thorough manner every venture upon which he embarked, while by the latter he attracted and tamed his captives in a manner peculiarly his own. Born in a suburb of Hamburg in 1844, young Hagenbeck early acquired an interest in animals from his father, and eventually succeeded in securing the greater portion of the world's trade in wild beasts. In fact, if an animal was wanted you had but to tell Hagenbeck, and, unless war or other political obstacles barred the way, it was practically sure to come. But Hagenbeck's fame was largely based on his novel ideas with regard to the treatment of wild animals in confinement, more especially in the matter of an outdoor life for tropical species in Europe, and in the abolition of visible walls and bars, so that spectators might behold the captives in a state of comparative freedom. These ideas were embodied in the animal park at Stellingen. In 1899 Hagenbeck published, under the title "Von Tieren und Menschen," an account of his life and experiences, an abbreviated English translation of which appeared during the same year.

The South Metropolitan Gas Company has appointed Mr. J. S. G. Thomas as research physicist to undertake investigations for technical purposes.

The death is announced, at fifty-two years of age, of Prof. A. C. Elliott, professor of engineering at the University College of South Wales and Monmouthshire, and president of the Institution of Locomotive Engineers.

Mr. A. R. Hinks, F.R.S., chief assistant at the Cambridge University Observatory, has been appointed Gresham professor of astronomy, London, in succession to the late Mr. S. A. Saunder.

Prof. L. J. Landouzy, dean of the Paris faculty of medicine, and known by his researches in connection with nervous diseases and tuberculosis, has been elected a member of the Paris Academy of Sciences, in succession to the late M. Teisserenc de Bort.

On Thursday last, April 17, Mr. G. Hamel, accompanied by a passenger, accomplished a non-stop flight on a two-seater Blériot monoplane from Dover to Cologne, the direct distance being nearly 250 miles, in about four hours and a quarter.

At the ordinary scientific meeting of the Chemical Society, held on Thursday, April 17, the president, Prof. W. H. Perkin, F.R.S., announced that an extra meeting will be held in the rooms of the society on Thursday, May 22, at 8.30 p.m., when a lecture in honour of the memory of the late Prof. Jacobus Henricus van't Hoff, honorary and foreign member, will be delivered by Prof. James Walker, F.R.S., of Edinburgh.

A further valuable gift has just been made to the Hull Municipal Museums Committee by Mr. C. Pickering, the donor of the new Museum of Fisheries and Shipping at the Pickering Park. It was recently represented to him that the new museum was already crowded with exhibits, and he has kindly presented a strip of land stretching from the Hessle Road to the Pickering Park, and adjoining the present museum, for the purpose of extension.

On Tuesday next, April 29, Prof. W. Stirling will begin a course of three lectures at the Royal Institution on recent physiological inquiries. Owing to the illness of Prof. Bateson, his course of lectures on the heredity of sex and some cognate problems has been postponed. In addition to the Friday evening arrangements already announced, discourses will probably be given by Mr. F. Balfour Browne, Capt. C. G. Rawling, Prof. Silvanus P. Thompson, Mr. Owen Seaman, and Dr. Francis Ward.

Under its curator, Mr. A. G. Thacker, the Public Museum at Gloucester is being actively developed. The fine collection of Roman remains is being extended and rearranged. In the archæological department the museum has received from Sir W. T. Thiselton-Dyer a collection of the "river-drift" type of palæoliths. The Cotswold district abounds in Neolithic implements, which are here well represented. But in this latter department, by the gift of the fine collection made by the late Mr. G. B. Witts, the museum at Cheltenham holds, perhaps, a higher place. Between the two the Neolithic culture of the southern midlands is now admirably represented.

In the transmission of pathogenic trypanosomes of man and domestic animals by tsetse-flies in Africa there has been some difference of opinion amongst investigators as regards the connection between the infectivity of the fly and the invasion of its salivary glands by the trypanosomes. Kleine was of opinion that the development of *Trypanosoma gambiense* in *Glossina palpalis* was limited to the intestine of the fly, while the Royal Society's commissioners in Uganda considered that the invasion of the salivary glands was necessary to render the fly infective. In a memoir published in *Annals of Tropical Medicine and Parasitology* (vol. vi., No. 4), Kinghorn, Yorke, and Lloyd publish a number of experiments on the transmission of *T. rhodesiense* by *G. morsitans*, which prove in the most convincing manner that the fly only becomes infective when its salivary glands are invaded and is non-infective when the trypanosomes are confined to the intestine only, even if swarming in this part. The trypanosomes found in the salivary gland resemble the stumpy form found in mammalian blood, and differ from the predominant type found in the intestine of the fly. The same result has been obtained by Miss Muriel Robertson in her researches on the development of *T. gambiense* in *G. palpalis* (Phil. Trans. (B), vol. cciii.).

The fresh-water fishes of South Africa form the subject of an illustrated report by Messrs. Gilchrist and Wardlaw Thompson, published as part 5 of vol. xi. of the Annals of the South African Museum. It is based on collections in the South African, Bulawayo, and Transvaal Museums, a large proportion of which was procured by the aid of grants from the British and the South African Associations for the Advancement of Science. A considerable number of species are described as new.

According to the report for the past year, the Rugby School Natural History Society continues its activity in all branches, the entomological section being particularly remarkable for its energy, as exemplified by a long list of the species of four orders of insects collected in the neighbourhood. We have also received the seventy-ninth report of the Bootham School Natural History, Literary, and Polytechnic Society, in which it is recorded that two of the members obtained prizes at a public-school essay competition arranged by the Royal Society for the Protection of Birds.

Mr. G. Fischer, Jena, has sent us a reprint from the "Handwörterbuch der Naturwissenschaften," entitled "Leitfaden der Descendenztheorie," by Prof. L. Plate, of Jena (price 1.60 marks). The author attempts in fifty-five pages, of which nearly half the space is occupied by illustrations, to sketch the outlines of the evidence on which the evolution theory is based. When the difficulties of compressing the subject to this extent are remembered, the result must be regarded as remarkably successful. All the chief lines of argument are mentioned, with the exception of those derived from the study of heredity and experimental morphology, which are dealt with in a separate section of the *Handwörterbuch*. The style is simple, and the cases chosen in illustration well suited to the purpose, but it is perhaps unfortunate that scarcely any examples are taken from the vegetable kingdom.

In the report of the American Museum of Natural History for 1912 attention is directed to the policy of instituting exploring and collecting expeditions, rather than depending on purchase, as the chief means of increasing the collections. "While specimens for exhibition are the chief aim of the explorer, he brings back a large amount of information regarding the country visited, as well as photographs, drawings, or paintings, which are absolutely essential both for publication and as accessories to exhibition. . . . In all, thirty-five parties were operating in the field during the year 1912; every continent on the globe except Australia has been visited, and remarkable success has crowned the efforts of the leaders." Illustrations of several of the new exhibits, including one of a fine pair of African forest-hogs, render the report highly attractive.

The report of the Dove Marine Laboratory, Cullercoats, for the year ending June 30, 1912, deals with a considerable number of subjects bearing more or less directly on practical fishery questions. In most cases these are dealt with very briefly, and it might perhaps be suggested that conclusions of more permanent value would be reached if fewer subjects were investigated, and those that were attempted were more thoroughly and exhaustively done. The paper by B. Storrow on *Nephrops norvegicus* is the most satisfactory from this point of view, and is based on a somewhat extensive collection of valuable data. The note on the spawning of the plaice by the same author, on the other hand, with its accompanying plate, seems to be of only trifling value, and might well have been allowed to rest in the laboratory notebook until further and more conclusive observations could be added. Prof. Meek contributes short papers on lobster culture, on mussel culture, and on the protection of crabs and lobsters, and measurements of certain samples of herrings are also recorded.

In the current number of *The Quarterly Journal of Microscopical Science* (vol. lviii., part 4) Mr. G. E. Johnson gives an account of those familiar yet little-known organisms, the nematodes of the common earthworm. Larval nematodes occur abundantly, both encysted in the body-cavity and in an active condition in the nephridia. These are shown to belong to the same species, which the author distinguishes as "*Rhabditis pellio*, Bütschli, non Schneider." As Schneider's species was described first it is obvious, as the author points out, that a new specific name will be required for the form under discussion, but he refrains from giving this name until Schneider's species shall have been re-examined. Apparently the nematodes do no harm to the earthworm, and they only reach the adult condition in the decaying body of the worm after the latter has died. There is no evidence of another host, but the complete life-history is not yet known. Another paper of interest from the point of view of economic zoology is by Mr. J. Davidson, being the first part of an elaborate memoir on the structure and biology of the woolly aphis of the apple-tree, often known as the American blight. Captain Meek contributes a useful discussion on the mechanism of mitosis, from which it appears very evident that, in spite of numerous theories, no satisfactory explanation of the phenomena has yet been arrived at. The only general conclusion that can be drawn at present appears to be "that the mitotic spindle is not a figure formed entirely by the action of forces at its poles."

The April number of *Bedrock* (vol. ii., No. 1) offers a varied and interesting bill of fare to its readers, ranging from a study of Japanese colonial methods, by Miss Ellen Churchill Semple, to Prof. H. H. Turner's essay on the nebular hypothesis and its developments. Miss Semple's article affords an interesting glimpse of the up-to-date application of scientific principles to colonisation as practised by the Japanese. In the island of Formosa the savage aborigines are isolated by means of a wire fence 300 miles long, the lowest wire of which is charged with an electric current strong enough to stun or kill anyone trying to climb over or creep under it. The fence is guarded at intervals of 500 yards by block-houses with armed police, one of whose functions is to receive the natives within the pale of civilisation when they are prepared to submit, and thenceforth to educate and look after them generally. Prof. Poulton contributes a very useful account of the latest advances in our knowledge of the phenomena of mimicry, as illustrated by the African Papilioninæ. It will be remembered that the polymorphic females of certain species of this group of butterflies are adapted to mimic various species of Danainæ and Acræinæ in different parts of the continent, and that one and the same female may produce several different forms of mimicking offspring. Prof. Poulton dismisses the suggestion that the different forms of mimicking pattern have arisen by sudden mutation, and brings forward evidence to show that they have been produced gradually by natural selection. At the same time he adduces evidence which suggests that the different patterns may be inherited in Mendelian fashion. The discussion on telepathy as a fact of experience is continued by Sir Oliver Lodge and Sir Ray Lankester, and Mr. McDougall has a very interesting article on modern materialism, in which he discusses the question of Vitalism *versus* Mechanism. Considerations of space prevent us from mentioning other valuable contributions.

Reprints have been received of two interesting papers dealing with the evolutionary aspects of plant ecology, one by Rev. G. Henslow ("Evolution considered as Bearing upon the Evolution of Plants," *Scientia*, vol. xiii., 1913, 19 pp.), and the other by Mr. L. Cockayne, F.R.S. ("Observations Concerning Evolution Derived from Ecological Studies in New Zealand," Trans. N.Z. Inst., vol. xliv., 1912, 50 pp., 8 plates). The latter is of especial importance from the wealth of observational data which it contains, throwing light upon various problems in the ecology and biology of plants in general, and suggesting many others which are open for investigation. It is not possible here to analyse these publications, which will doubtless receive attention in the newly founded *Journal of Ecology*. It must suffice to say that both authors urge that students of evolution have not paid sufficient attention to the material drawn from the ecological study of vegetation, and that many facts concerning the relation of plants to environment can only be adequately explained on the assumption that characters evoked by stimuli affecting the body-cells are emphatically capable of being inherited.

Lady Isabel Browne has sent a reprint of "Contributions to our Knowledge of the Anatomy of the Cone and Fertile Stem of Equisetum" (*Annals of Botany*, vol. xxvi.), from which it appears—as so frequently happens—that the re-investigation of the structure of even the most familiar plants, especially those belonging to groups which had a much greater development in the past than at the present day, results in the filling-up of various gaps in the knowledge of these groups. The author gives an historical introduction indicating previous work done on this much-investigated genus, and after presenting the results of her own thorough examination of the anatomy of the cone and fertile stem of several horsetail species, discusses the general organisation of the cones in the recent and extinct Equisetales. The structure of the cone axis or stem supports the view that the spore-bearing organs (sporangiophores) are whole appendages and not lobes of a sporophyll or leaf. The collar-like outgrowth (annulus) below the cone in recent horsetails appears to represent a reduced node;

this is confirmed by the anatomy of abnormal specimens of the field horsetail in which more than one annulus is present.

THE report of experiments carried out in 1912 at the Harper Adams Agricultural College and in Shropshire and Staffordshire contains accounts of inquiries into the effect of pruning and of grass on fruit trees, the wart disease of potatoes, the manuring of grass land for milk, &c. During the past year oats in many parts of the country were badly attacked by the frit-fly (*Oscinis frit*), and since the life-history of this pest is not fully known, investigations in this direction have been instituted. Although preventive measures cannot be given at present, it may be noted that early sown crops are not so liable to attack as those sown later, and also that a dressing of nitrate of soda helps the plant to recover from initial attack by the pest. How far the severity of attack depends on the variety of oat has still to be ascertained, but striking differences were observed among the varieties cultivated last year.

MESSRS. E. S. SALMON and C. W. B. WRIGHT contribute a paper to the March number of the Journal of the Board of Agriculture on lime-sulphur wash for American gooseberry mildew. As a result of extended observations it has been found that different varieties of gooseberries differ to a marked degree as regards the susceptibility of the foliage to injury from the wash. It is possible with some varieties, *e.g.* "May Duke," to spray repeatedly throughout the season with lime-sulphur, at a strength (1·01 sp. gr.) sufficient to prevent the attacks of the mildew, without causing any injury to the foliage. In other cases it seems probable that the foliage of a variety may be resistant to injury from the wash, while showing susceptibility later in the season. Other varieties, such as "Valentine's Seedling" and "Yellow Rough," are so sensitive that they cannot safely be sprayed with lime-sulphur.

THE report of Stonyhurst College Observatory (Lancashire) for 1912 contains results of meteorological, magnetical, and seismological observations, together with mean and extreme values for the last sixty-five years. Some of the meteorological results for last year are noteworthy from several points of view. The annual rainfall was $7\frac{1}{4}$ in. above the average; in March the amount was more than double the average, and was the greatest on record for that month. The duration of bright sunshine was nearly 410 hours below the yearly average (thirty-two years); August had only 50 per cent. of the normal amount, and the maximum temperature was 11·6° below its average highest reading. Father Sidgreaves states that owing to the decision of the Meteorological Office to reduce the number of its observing stations the connection of Stonyhurst with the office would cease at the end of March, but we are glad to learn that the automatic recorders are to remain there, and will be kept in active service. This observatory is one of those adopted by the first Meteorological Committee (1867) for the continuous registration of meteorological phenomena at important positions in the British Islands. In the report of the Meteorological Committee for the year ended March 31, 1912, it was explained that the urgency of questions connected with the upper air had decided it to withdraw in some cases the grants made for the continuance of observations in the old form.

PART 5 of the first volume of the science reports of the Tohoku Imperial University, Japan, contains a paper on the magnetic susceptibilities of iron, steel, nickel, and cobalt up to temperatures of 1300° C., by Profs. Honda and Takagi. The method used depends on the measurement of the force under which the magnetisable material moves from a weak to a strong part of the magnetic field in which it is placed. The field was provided by a small du Bois electromagnet, and the force was measured by means of a delicate spring balance. The materials tested were placed in a small magnesia capsule surrounded by an electric furnace. The temperature of the specimen was determined by means of a platinum platinum-rhodium thermo-junction standardised by the use of the melting points of lead, zinc, antimony, copper, and nickel. As the result of their investigations, the authors find that Curie's law, according to which the susceptibility should vary inversely as the absolute temperature, does not hold for nickel below 500° C., does not hold over any extended range of temperature for cobalt, and is not even approximately true of iron or steel in what is known as the γ state above 800° or 900° C.

MESSRS. TOWNSON AND MERCER, LTD., have sent us a specimen of a new type of inorganic filter for laboratory purposes. The filter is cone-shaped, and is understood to be composed of powdered alundum (a variety of fused alumina) cemented by firing with siliceous material. It is sufficiently porous to allow of rapid filtration, is not sensibly affected by solutions of common chemical reagents, and withstands the usual temperatures employed in the laboratory. For use, it is fitted into an ordinary glass funnel by means of rubber tubing, and connected with a filter-pump. Paper filters can be employed with it, or not, according to requirements. One of the chief advantages is that the filter can be used for quantitative determinations in the same manner as a Gooch type of filter, but without the trouble of preparing an asbestos layer every time. A light aluminium stand is supplied for convenience in weighing. How far any difficulty of cleansing or liability to fracture might prove troublesome, only extended trial could show; but a few summary experiments indicate that the filters will probably be very convenient for many gravimetric chemical operations. The makers are the Norton Company, Massachusetts.

IN the course of an article on the relation of engineering and architecture, *The Builder* for April 11 suggests two main considerations as accounting for the division which now exists: one, the public willingness to accept great works of engineering as necessary evils from an æsthetic point of view; the other, the greater extent to which the engineer must be immersed in the practical considerations of high mathematical problems which have to be solved in connection with many engineering works. The latter, it is asserted, tends to the narrowing of the mental point of view. The remedies suggested are the education of public opinion so that it will demand the æsthetic treatment of engineering work, and the unification of engineering and architecture as component parts of one calling. Our contemporary considers that the engineer should have a preliminary training in architecture, and that the architect would be the better artist if he had studied something of the principles which underlie engineering, instead of going through the world content to hoe his own furrow irrespective of the general field.

Engineering for April 18 contains a very full illustrated description of the new Cunard liner *Aquitania*, which is being built and engined by Messrs. John Brown and Co., Ltd., of Clydebank. This vessel is the largest ship yet built for the express service to New York. The following are the principal dimensions:—Length over all, 902 ft.; breadth, 97 ft.; depth, 64 ft.; displacement, 49,400 tons; shaft-horse-power of the four-screw steam turbines, 60,000; 4230 passengers and crew are provided for. There are forty-one watertight compartments in the double bottom, and eighty-four watertight compartments in the moulded structure of the ship above the double bottom, formed by transverse and longitudinal bulkheads and watertight decks. The transverse bulkheads have been carried up to an unusual height. The conditions are such that should the fore part of the ship for the first five compartments, or the after part of the ship for the six after compartments, or the five centre compartments, be open to the sea, the ship would still remain in a perfectly stable condition. To render possible the launching and navigation of the vessel to the sea, it has been necessary to widen and deepen the channel of the River Clyde, a work which will be of lasting benefit to navigation. The ship was launched successfully on Monday last.

IN the announcement of Canadian tide tables made in NATURE of March 27 (p. 95), it was implied that they are issued by the Government Printing Bureau at Ottawa, whereas, Mr. W. Bell Dawson writes to point out, they are merely printed there, and are prepared and issued under his direction from the office of the Tidal and Current Survey, Ottawa. It may here be mentioned that the Tide Tables are issued in two series, which refer to eastern Canada and the Pacific respectively, the tides of two oceans 3000 miles apart, on opposite coasts. The work of the Canadian Survey is thus very extended, and the limited staff which carries it on is beginning further investigation in Hudson Bay, an area much larger than the North Sea, and quite as complex in its tides.

OUR ASTRONOMICAL COLUMN.

THE SOLAR UNION AT BONN.—The fifth meeting of the International Union for Cooperation in Solar Research will be held in the Physical Institute of the Bonn University on July 31 next, and a preliminary programme for that occasion has now been circulated. On the evening of July 30 a reception will be held in the large hall of the reading and recreation society, and the mornings of July 31, August 1 and 2, and afternoons of the two former dates, will be devoted to the discussions. The afternoon and evening of August 2 and the whole day of August 3 will be taken up with a visit to Cologne, a reception being given in the hall of the Gürzenich at the invitation of the city of Cologne, and probable alternative excursions to (1) motor through the Eifel to the valley of the Mosel, and (2) tour in the Siebengebirge. August 4 and 5 will see the resumption of the meetings, and the afternoon of the latter date may be employed in a steamer trip on the Rhine. In addition to the above, Prof. Küstner will receive the members at the observatory on the afternoon or evening of August 1, Prof. Karl Hausmann invites them to visit the Technical High School at Aachen, and the Astrophysical Observatory at Potsdam invites members for August 11.

A CASE OF LARGE PARALLEL PROPER MOTION.—Dr. Ragnar Furuhjelm, of the Helsingfors Observatory, communicates to the *Astronomische Nachrichten* (No. 4642, p. 179) an instance he has found of two stars fairly wide apart having the same velocity and direction of proper motion. The stars in question are a double star, BD $+45^\circ$ 4408 and No. 12740 in Burnham's catalogue (8·3 m. and 8·3 m., α=0h. 0m. 23s., $\delta=+45^\circ$ 15·5′, 1900·0), the proper motion of which was earlier known and measured, and a star of the magnitude 9·5 m., its distance from the above binary being about 5·5 minutes of arc. Dr. Furuhjelm gives in detail the measures he made of both these stars on several plates which he had taken at different times in that region, and deduces the value of 0·9″ for the proper motion of the system, and 327·58″ and 254° 13·7′ for the distance and position angle of stars. Finally, he directs attention to another similar case of large parallel proper motion as is exhibited in the stars A Ophiuchi and 30 Scorpii, which are about 12·2′ apart, and undergo a proper motion of 1·25″. In this instance also one of the stars is a double with a distance of 4·2″. Such systems form important objects for study.

THE SOLAR ROTATION IN 1911.—In the March number of *The Astrophysical Journal* (vol. xxxvii., No. 2) Messrs. J. S. Plaskett and Ralph E. DeLury describe and give the results of their very thorough investigation relating to the spectroscopic determination of the solar rotation. The work was carried out at the Dominion Observatory at Ottawa, the observatory having undertaken this programme of work on the lines determined by the International Union for Cooperation in Solar Research. The instrumental equipment at the Ottawa Observatory is of first-rate quality, and is all that is needful for the research which has been so successfully brought to an issue. The communication in question is of considerable length, and the authors describe and discuss the difficulties met with as regards personalities in measurement, instrumental errors, &c. The chief conclusions to which they ultimately reached were that the values they deduced for the solar rotation could be represented by formulæ which were in exceedingly good agreement with those obtained by Dunér and Adams (1908), except for a small and nearly constant angular difference. The absolute velocity of the solar rotation seems to be uncertain by a small amount, amounting to 2 or 3 per cent., due, as they suggest, to personal differences in the habit of measurement of the rotational displacements on the plates. No systematic differences of velocity were found for different elements, although they discussed 3000 residuals from different lines and elements. It is of interest to give here the different formulæ for the rotation as deduced by the authors and previous investigators:—

	Angular velocity.
Dunér	$10{\cdot}60^\circ + 4{\cdot}21^\circ \cos^2 \phi$
Halm	$12{\cdot}03^\circ + 2{\cdot}50^\circ \cos^2 \phi$
Adams (1908)	$10{\cdot}57^\circ + 4{\cdot}04^\circ \cos^2 \phi$
Adams (mean)	$11{\cdot}04^\circ + 3{\cdot}50^\circ \cos^2 \phi$
Plaskett (1911) ...	$10{\cdot}32^\circ + 4{\cdot}05^\circ \cos^2 \phi$
DeLury (1911)	$10{\cdot}04^\circ + 4{\cdot}00^\circ \cos^2 \phi$

THE TENTH INTERNATIONAL GEOGRAPHICAL CONGRESS AT ROME.

THE report of progress and the discussion regarding the international map of the world and polar exploration were the two predominant subjects at the International Geographical Congress just concluded at Rome. The long postponement from October, 1911, to April, 1913, was sufficient to account for the meagre attendance of British representatives, of whom there were only ten, and indeed foreign members as a whole. Polar exploration—both arctic and antarctic—was, however, well represented. Of the former, Admiral Peary, Admiral Cagni, Dr. Bruce, Mr. Bridgeman, and Mr. Stefánsson were representative, whilst Dr. Bruce, Dr. Nordenskjold, and Lieut. Lecointe represented antarctic exploration. There were also many others specially interested in polar research, as was testified by the presence of thirty delegates at the Polar Commission, which took the opportunity of meeting at the same time and place as the Geographical Congress. Although no striking results have accrued from this rather anomalous body, yet it gives an excellent opportunity for polar explorers and their supporters to meet and discuss matters of common interest, and, being in strong force, special interest was naturally shown in their work, and several important communications given.

International Map.

The most important result of the congress was the discussion and agreements reached regarding the international map of the world on a scale of 1 : 1,000,000. The British representatives who took special part in this section were Col. C. F. Close, Director-General of the Ordnance Survey of Great Britain; Col. W. C. Headley, Mr. F. Grant Ogilvie, C.B., and Mr. G. G. Chisholm. General Jules de Shokalsky, St. Petersburg; Prof. Albrecht Penck, Berlin; Engineer Charles Lallemand, and Prof. Paul Helbronner, Paris; Lieut. A. H. Byström, Stockholm; Dr. H. von Hartenthurn, Vienna, also took part in the discussion. Nine States had undertaken the production of sheets of the international map in accordance with the resolutions of the official conference held in London in November, 1909, namely Argentina, Chile, France, Great Britain, Hungary, Italy, Japan, Spain, and the United States, and preparation work was also reported by the delegates of Portugal and Sweden, and the thanks of the congress were voted to those States.

By direction of the president of the congress in accordance with the resolution proposed by Prof. Penck, and approved at the general meeting of the congress, March 29, delegates of all countries interested in the international map held a meeting on March 31, 1913, and passed the following resolutions unanimously, and the resolutions were submitted to the congress:—

(1) It is desirable that another official conference should be held to consider questions affecting the international map of the world on the scale of 1 . 1,000,000, in the capital of a State which has already undertaken the preparation of sheets of the map; and it is thought that it would be convenient to all concerned if this capital were Paris.

(2) In view of the fact that the general principles governing the construction of the map are already settled and adopted, the new conference should be asked to consider questions of detail only, such as the size of the lettering, character for railways, &c.

(3) It is desirable that all civilised States should be invited to send delegates to the proposed conference.

(4) It would be convenient if the date of the proposed conference were towards the end of the year.

(5) London (Geographical Section of the General Staff, War Office) remains the official centre of the undertaking until the assembly of the proposed conference, and communications of interest with regard to the international map should be addressed to that office. Also, it is desirable that a set of not fewer than fifty copies of a selected sheet already printed should be sent by each country which has produced a sheet or sheets to the above office, at an early date. These sheets will be distributed to those Governments invited to the new conference, and to recognised private authorities.

Polar Exploration.

In arctic exploration special interest was also shown in Mr. Vilhjálmur Stefánsson's plans of the Canadian Arctic expedition, which leaves Vancouver about June 1 for a period of three and a half years. As a preliminary to laying these plans before the congress, Mr. Stefánsson gave a detailed account in two sections of his six years' work on the Mackenzie River and along the arctic shores of Canada and on the islands to the north. During practically the whole of that time he lived as an Esquimaux among Esquimaux, learning their language and many of their customs, and making himself dependent on the resources of the country. By this account of his previous work he showed that no one was better fitted to carry out the plans of the new Canadian Arctic expedition, which he himself had formulated. It was of special interest to hear Mr. Stefánsson emphasising not only the importance, but the great accuracy of the work of the late Dr. John Rae.

Mr. Stefánsson's plan generally is to explore the Beaufort Sea and to seek for new lands to the north-west of those known islands lying to the north of the mainland of Canada, and to carry on further research, especially as regards his discovery of Esquimaux of a blonde type living to the north-west of Victoria Land. Special interest attaches to the expedition, because the theory which Mr. Stefánsson and others have is that the tides indicate a considerable area of land lying in the Beaufort Sea to the north-west of Victoria Land.

Admiral Peary, in supporting the plans, pointed out that the American Geographic Society and the American Museum of Natural History had in the first place come forward, each offering to pay half, but that subsequently the Government of Canada had desired to make the expedition a Canadian one, seeing that it was for the exploration of Canadian arctic regions, and had offered to pay the whole cost. They in the United States appreciated the attitude of Canada. They had followed Mr. Stefánsson's past and present work with the greatest interest, and wished his expedition the success it deserved. Dr. Bruce, in supporting the proposal, pointed out how, whereas the Pacific side of the south polar regions had received most attention from explorers, it had been on the Atlantic side that the north polar regions had been chiefly explored. This was due, he said, to the fact that the Atlantic side of the arctic regions was nearer the centres of civilisation. The regions Mr. Stefánsson intended to explore was particularly interesting from the oceanographical point of view, because no oceanographical research had been carried out on the Behring Straits side of the Arctic Ocean. Mr. Stefánsson was taking with him a considerable oceanographical equipment and an excellent oceanographer, in the person of Mr. James Murray, who had done signal service with Sir John Murray in the Scottish Loch Survey, and with Sir Ernest Shackleton in the antarctic regions. He thought the action of the Canadian Government was to be applauded, and served as an example to other Governments on this side of the Atlantic.

Mr. Bridgeman gave a note on the Crocker Land expedition, as well as an interesting eulogy on Admiral Peary, entitled "Peary: the Man and His Work." Mr. Bridgeman showed a most beautiful series of slides of arctic scenery. Among other arctic papers was one by Dr. O. J. Skattum, of Christiania, on the map of Spitsbergen. Excellent as is the recent work of the Norwegians in Spitsbergen, he made a serious omission by making no reference to the highly detailed geodetic work in Prince Charles Foreland that has been done by Dr. W. S. Bruce and Mr. John Mathieson in 1906, 1907, and 1909. Neither did he acknowledge the financial and other help given to the Norwegians by the Prince of Monaco, who has also helped the Scottish expeditions. Dr. Skattum should spell "Spitsbergen" with a central "s" and not "z." the word being of Dutch and not German origin.

An arctic paper of great interest and importance was given by General de Shokalsky, who also made several other important communications. It was on the work carried out by the officers of the Russian Navy and the Russian Geographical Society during the last twelve years. This work includes much detailed and valuable geographical research, on strictly scientific lines, that has been done along the arctic shores of Russia and Siberia, and seas adjacent. His paper on the new hypsometrical map of the Government of Moscow on a scale of 1 : 168,000 might also be regarded as an important contribution to arctic geographical research.

Antarctic Research.

Dr. W. S. Bruce gave an account of his plans for another Scottish Antarctic expedition, which have already been given in detail at a meeting of the Royal Scottish Geographical Society, and for which the treasurer of the society is receiving subscriptions amounting already to a considerable but, as yet, by no means adequate amount. The plans, it will be remembered, are to carry out further extensive oceanographical research in the region of the Weddell Sea, to explore the continent in the neighbourhood of Coats Land, and to complete a sectional survey of Antarctica, by a journey across from the Atlantic to the Pacific side of the continent. The plans were very strongly supported by Admiral Peary, who urged the special importance of a journey to the south pole on the Weddell Sea side of Antarctica, and the importance of detailed oceanographical research. He agreed with Dr. Bruce that there was plenty of room for many nations to work together in the antarctic region, and hoped that the United States would take part in the south polar campaign. Mr. G. G. Chisholm, secretary of the Royal Scottish Geographical Society, said that the plans had the hearty support of that society. The plans were also cordially supported by Prof. Penck, of Berlin, who referred to the work of Lieut. Filchner and his important discovery of an extension of Coats Land to the south-west. Dr. Otto Nordenskjold's was the other antarctic contribution, namely, "A Comparison of the Inland Ice of Arctic and Antarctic Lands," an important contribution to glaciology.

Dr. Gerhard Schott, of Hamburg, gave an account of recent German oceanographical research in the Atlantic Ocean, and Prof. Drechsel, of Copenhagen, dwelt on the importance of continuous and periodic hydrographic researches carried on at definite stations, such as has been carried out recently by the Prince of Monaco and Dr. Richard in the Mediterranean. Prof. J. Thoulet, of Nancy, dwelt on the construction and utility of bathy-lithogical submarine charts, a paper that was in many respects very suggestive. Miss Owens's account of the geysers of Yellowstone Park was an important contribution.

On the whole the papers were of good quality, and showed the result of steady geographical research during the past four and a half years. But there is little doubt that the congress was seriously affected by the postponement on account of the Turco-Italian war, many who had offered contributions withdrawing them and presenting them to various geographical societies in the meantime.

It was resolved to hold the next congress at St. Petersburg on the invitation of the Russian Government, presented to the congress by General de Shokalsky.

A rather heated discussion arose on the question of introducing Spanish as an official language, but this proposal was withdrawn, a special veto being given to the proposal by General de Shokalsky threatening to introduce Russian as an official language if the proposal were insisted on.

INTERNATIONAL METEOROLOGY.

A MEETING of the International Meteorological Committee was held in Rome on April 7–12, at the invitation of Prof. Palazzo, director of the Italian Meteorological Service. The meeting was attended by Dr. W. N. Shaw, president of the committee, Geheimrat Hellmann, the director of the Prussian Meteorological Service, secretary, and the following members, representing the meteorological services of their respective countries:—*France*, M. Angot; *Portugal and Azores*, M. Chaves; *Holland*, M. van Everdingen; *Sweden*, M. Hamberg; *Switzerland*, M. Maurer; *Italy*, M. Palazzo; *Denmark*, M. Ryder; *Russia*, M. Rykatcheff; and *Canada*, Mr. Stupart. There were also present Prof. Hergesell, the president of the International Commission for Scientific Aëronautics, and Prof. Bjerknes, who had made important proposals, at the meeting of this commission held in Vienna in 1912, regarding the form in which meteorological data for the upper air should be published. At the opening meeting letters expressing regret at their inability to attend the meeting were read from Prof. Mohn, *Norway*; Prof. Willis Moore, *United States of America*; Prof. Nakamura, *Japan*; and Dr. G. T. Walker, *India*.

It is the function of the International Committee to deal with questions of organisation in which international cooperation is required. A considerable number of such questions has become ripe for consideration by the committee in the three years which have elapsed since the last meeting, held in Berlin in 1910.

After the conclusion of the formal inaugural business the first meeting was devoted to the consideration of a letter which had been received from the president of the International Institute of Agriculture, asking for the assistance of the committee in furthering questions connected with the influence of the weather in agricultural affairs. Apart from questions connected with weather forecasting, there are many problems connected with the influence of weather on the yield or quality of crops or the suitability of particular climates for particular crops which are capable of advancement by statistical methods, but as yet little progress has been made in this direction. The committee finally appointed a permanent commission to undertake the further working out of these questions. M. Angot was asked to act as president of this commission, and MM. Börnstein, Brounow, Louis Dop, Hergesell, Palazzo, and Stupart as members, it being understood that the commission would coopt additional members.

The second day's sitting was devoted to the consideration of the report of the Commission on Weather Telegraphy, which had held a meeting in London in September last, and of the comments which had been received from the various institutes concerned on the proposals of the commission. Apart from a few minor modifications, the committee approved the recommendations of the commission, which have been already referred to in a previous number of Nature (vol. xc., p. 107). The institutes are invited to introduce the suggested modifications in the present arrangements for exchange of telegraphic meteorological reports within the European system on May 1, 1914. From that date onwards a uniform telegraphic code will be adopted throughout Europe, though the differences between the units adopted in this country and on the Continent will persist. Arising out of the report of the commission was the question of the receipt of information from ships at sea by wireless telegraphy. Up to the present this country stands alone in having a system for obtaining wireless reports from liners. Our geographical position invests such reports with special importance to us. It is now hoped that the regulations connected with weather radio-telegrams adopted at the International Radio-telegraphic Conference, held in London in the summer of last year, will result in a considerable curtailing of the time which these messages occupy in transmission. Should this anticipation be realised, it is probable that other countries would also desire to avail themselves of this means for securing information from the Atlantic Ocean, and the president was therefore requested to make inquiries regarding the matter.

At this meeting the committee also considered a report on the velocity equivalents of the numbers of the Beaufort scale of wind force in use in different countries drawn up by Messrs. Palazzo, Köppen, and Lempfert, by request of the Commission on Weather Telegraphy. The report showed that the equivalents used in different countries differ considerably, but they all have one feature in common, viz., that they are based on comparisons of estimates of wind force with hourly means of wind velocity as measured on Robinson cup anemometers. The last few years have witnessed a considerable advance in our knowledge of wind structure in consequence of demands which have been put forward by aviators, and thus the question arises whether the velocity in gusts should not find a place in any specification of the velocity equivalents of the Beaufort numbers that may be recommended for general international use. For this and other reasons the committee considered it inexpedient at the present juncture to recommend a definite scale of equivalents for general use, and contented itself with suggesting that if any meteorological service wishes to make a change in the hourly equivalents which are now in use, the new values should be so selected that they do not fall outside the limits set by the scales adopted in Germany and in this country. The gentlemen referred to above were requested to prepare a further report, on which the committee might base a more definite recommendation on some future occasion.

At the next meeting questions arising out of the investigation of the upper air were considered. M. Hergesell gave an account of the past work and future plans of the commission of which he is president. In connection with future plans, he stated that upper-air investigation would form an important part of the scientific work proposed by Capt. Amundsen in his projected drift across the polar basin in 1915, and it thus was very desirable to organise other observations in polar latitudes simultaneously with Capt. Amundsen's expedition. In connection with this subject, M. Rykatcheff stated that Russia contemplated carrying out soundings of the upper air at Jakoutsk and Verkhoyansk, and that there was also some prospect of expeditions being sent to Nova Zemlya and to the mouth of the Lena at the time of Amundsen's expedition, if other countries were prepared to cooperate in other parts of the polar basin. Inquiries elicited the fact that prospects seemed favourable for such cooperation. Thus M. Hergesell hoped to be able to arrange for the German station on Spitsbergen to remain in operation, and Mr. Stupart thought that he might be able to arrange for some work of the kind contemplated by the Stefánsson expedition which the Canadian Government is sending out. The committee warmly supported the proposal, and appointed MM. Hergesell, Rykatcheff, Ryder, and Stupart a small subcommittee to deal with the question.

A second question of importance arising out of the upper-air work concerned the units to be adopted in the international publication in which the results of ascents made in all parts of the world are collected. A proposal brought forward by Prof. Bjerknes had led the commission responsible for this work to adopt at its meeting in Vienna in 1912 a resolution recommending that pressure values should be given in absolute units, millibars, instead of in millimetres of mercury, with the proviso, however, that the recommendation should only become effective when it received the approval of the International Meteorological Committee. The proposal has given rise to acute controversy in meteorological periodicals during the past year. Absolute pressure units are in many ways particularly suited to upper-air measurements, and no one would oppose their use if it were possible to start afresh without reference to the material which has been already collected and published in other units. Actually opinion has been sharply divided between those who trust that the temporary inconveniences associated with all changes will soon be outweighed by the advantages accruing from the new system, and those who deprecate any departure from established practice. After considerable discussion, the committee met the difficulty by requesting the commission to print pressure values in absolute units, millibars, as well as in millimetres of mercury. The committee further recommended that this practice should be adopted in all publications giving the results of observations in the free atmosphere. Thus a very difficult question has been settled for the present at the expense of a slight increase in the number of figures to be printed. A further proposal, originating with Prof. Bjerknes, to give heights in "dynamic meters," or rather to give geopotential instead of height in units of length, was referred back to the commission for further consideration, at M. Hergesell's request.

At the following meeting the report of M. Maurer, the president of the Radiation Commission, was received. A letter from Mr. Hunt, the meteorologist of the Commonwealth of Australia, directed the attention of the committee to the Campbell-Stokes sunshine recorder. Instruments of this type are widely used for recording the duration of bright sunshine, and their indications are generally regarded as reasonably comparable *inter se*. It appears, however, that the British Meteorological Service alone has adopted a definite specification for the instrument, but there is no similar provision in other countries. The Radiation Commission was therefore requested to take into consideration the question of instituting comparisons between instruments of different form.

At the last meeting the report of the Commission on Maritime Meteorology and Storm Warning Signals was considered. The recommendations of the commission regarding day and night signals, drawn up at the meeting held in London in September, 1912, were adopted except for a few points, such as the night signal for a hurricane, which was found to be likely to be confused with other signals already in use. These recommendations have already been described in NATURE (*loc. cit.*). A substantial measure of international agreement in the matter of day and night storm warning signals has thus been attained.

The Rome meeting of the committee was the third which has been held since the Conference of the Directors of Meteorological Observatories and Institutes which met at Innsbruck in 1905. In accordance with established practice another conference of directors should be held before the committee can hold another meeting, and it was agreed to call together such a conference for the year 1915. Holland was suggested as a suitable country for the meeting.

M. Palazzo had been at great pains to entertain his visitors and to afford them opportunities of seeing the geodynamical and meteorological observatories near Rome. On the Tuesday the committee was entertained at a dinner, at which the Chief Inspector of Mines presided on behalf of the Minister of Agriculture, who sent a message regretting his inability to be present in person. On Wednesday the members were received at the International Institute of Agriculture by its president, the Marquis de Cappelli. The whole of Thursday was devoted to an excursion which had for its object the seismological observatory at Rocca di Papa, with which was combined a visit to the Lake of Albano and to Frascati. On Friday afternoon the committee was invited to a meeting of the Physical Society at Rome, where it was welcomed by the president, Prof. Blascona, and subsequently listened to a lecture by Prof. Bjerknes on the fields of force.

On Saturday afternoon, April 12, the military observatory at Bracciano was visited by motor. This observatory has been recently established, and many of the instruments were not yet finally installed. It is fully equipped, not only for ordinary meteorological work, but also for taking aërial soundings with kites, registering or pilot balloons. A pilot balloon ascent was carried out in the presence of the visitors, who were subsequently entertained by the commandant and his officers.

NICKEL STEELS IN CLOCK CONSTRUCTION.

IN a pamphlet on "Les Aciers au Nickel et leurs Applications à l'Horologerie" (Paris, Gauthier-Villars), M. Ch-Ed. Guillaume gives in a simple form an account of the properties of nickel steels and of their application to the construction of compensated clocks, chronometers, torsion clocks, and even watches. The well-known peculiarities of the nickel steels as regards dilatation and variation of elastic modulus and other properties with temperature are briefly described and explained on the ground that the presence of nickel depresses the temperature of the allotropic modification which occurs in iron at 890° C., and at the same time changes the transformation point of iron into a wide range of transformation temperature in the alloys. It is when they are within this widened transformation range that these steels possess abnormally low coefficients of expansion, &c.

M. Guillaume's exposition of the applications of these steels shows, however, that although the alloy-steel known as "invar" can be produced so as to have negligibly low expansion, that is not the result to be desired for horological purposes. In the case of clock pendulums having an invar rod, with bob and suspension of other metal, the compensation principle of Graham, used in the mercury pendulum, is employed, but the use of a nickel steel of low expansion avoids the use of a liquid and makes the attainment of compensation both simpler and more perfect in its results. A steel of zero expansion would be less convenient.

More striking still is the application of nickel steel of a desired (low) coefficient of expansion to the balance-wheels of chronometers of high accuracy. Here the use of these special steels has made it possible to eliminate the second-order errors arising from the fact that compensation effected for two definite temperatures did not, with the older materials, avoid serious errors at intermediate temperatures, owing to the fact that the expansion curves of the two compensating metals only crossed at two points and lay widely apart at intermediate temperatures.

The elimination of this secondary error has made it worth while to seek other improvements in chronometer construction, so that an almost revolutionary improvement in these instruments has been brought about. For watches in which a compensated balance-wheel is excluded on account of cost, the use of a hair-spring of a special nickel steel, to which some chromium has been added in order to raise the naturally low elastic limit, has resulted in the evolution of a cheap method of producing compensated watches. In this case the abnormal manner in which the elastic modulus of these steels varies with temperature has been utilised.

The similar anomalous variation of the torsion modulus has also been utilised in connection with the construction of clocks with torsion pendulums, and has brought these clocks into the range of reasonably accurate instruments for the measurement of time. They have the advantage of requiring very little driving power, and can therefore run for four hundred days on a single winding.

M. Guillaume points out that these important developments must all be regarded as resulting from the study of the internal transformations of solutions and of alloys and that they have resulted indirectly from the study of nickel steels for purposes of metrology. The gradual and also the transient changes of dimension to which steels of the "invar" type are known to be subject are fortunately too minute to interfere with these applications, provided the steel has been properly aged.

W. ROSENHAIN.

VARIATIONS OF THE SPECTRUM OF TITANIUM IN THE ELECTRIC FURNACE.

ENHANCED lines are taking a more and more prominent part in the discussion of both terrestrial and celestial spectra, and another valuable contribution to the subject comes from the researches of Mr. A. S. King, of the Mount Wilson Solar Observatory (*Astrophysical Journal*, vol. xxxvii., No. 2, March). The investigation which he has in hand deals with variations in the spectrum of titanium by different temperatures of the electric furnace in order, if possible, to fix the place of the enhanced lines on the temperature scale. As enhanced lines are in general difficult to produce in the furnace, he made the attempt of forcing the furnace temperatures up in order to make them appear in the spectra. This he has very successfully accomplished, and in the process he has been able to observe several remarkable phenomena bearing directly on the nature of enhanced lines in general, which he describes in the present communication. Using larger dispersion than in his former experiments, and employing thinner tubes in the furnace, he ran the furnace until the tube wore thin with the strong vaporisation of the carbon, and ultimately broke. It was near this breaking period that the important observations were made.

The description of the experiments is given very fully in the paper, and is finely illustrated with reproductions of some of the spectra obtained, but here only the leading features of the research can be stated. The titanium enhanced lines appear in the regular furnace spectrum for temperatures probably somewhat higher than 2000° C., but are very faint compared with the arc lines. At still higher temperatures, the furnace conditions still existing, there is an indication of a slight increase in the relative strength of the enhanced lines. At the stage when the furnace tube burns through, resulting in the formation of a low-voltage arc, the consumption of electrical energy at the point being very large, the enhanced lines of titanium and the spark line λ4267 of carbon appear with an intensity usually attainable only in powerful sparks. Photographs taken with the slit across the entire image of the tube's interior show that the relative strength of the enhanced lines is much greater in the centre of the tube than near the wall, the effect being very pronounced in the case of the carbon spark line. Mr. King also directs attention to the important observation that the vapour in the centre of the broken tube shows a tendency to give a line farther to the red than near the wall, this being shown in the increasing dissymmetry of the lines from the end towards the middle. This effect, he points out, is in harmony with the action of the condensed spark, but can scarcely, in the case of the furnace lines, be ascribed to pressure.

ARISTOTLE AS A NATURALIST.[1]

AMONG the isles of Greece there is a certain island, *insula nobilis et amoena*, which Aristotle knew well. It lies on the Asian side, between the Troad and the Ionian coast, and far into its bosom, by the little town of Pyrrha, runs a broad and sheltered lagoon. It is the island of Lesbos. Here Aristotle came and spent two years of his life, in middle age, bringing his princess-bride from the petty court of a little neighbouring State where he had already spent three years. It was just before he went to Macedon to teach Alexander; it was ten years later that he went back to Athens to begin teaching in the Lyceum. Now in the "Natural History," references to places in Greece proper are very few indeed; there is much more frequent mention of places on the northern and eastern coasts of the Ægean, from Aristotle's own homeland down to the Carian coast; and to places in and round that island of Lesbos or Mytilene, a whole cluster of Aristotle's statements and descriptions refer. Here, for instance, Aristotle mentions a peculiarity of the deer on a neighbouring islet, of the weasels by the wayside by another island town. He speaks of the big purple Murex shells at Cape Lectum, and of the different sorts of sponges found on the landward and the seaward side of Cape Malia. But it is to the lagoon at Pyrrha that Aristotle oftenest alludes. Here were starfish, in such abundance as to be a pest to the fishermen; here the scallops had been exterminated by a period of drought, and by the continual working of the fishermen's dredge; here the sea-urchins come into season in the winter time, an unusual circumstance. Here among the cuttlefishes was found no octopus, either of the common or of the musky kind; here was no parrot-wrasse, nor any kind of spiny fish, nor sea-crawfish, nor the spotted nor the spiny dog-fish; and, again, from this lagoon, all the fishes, save only a little gudgeon, migrated seaward to breed. And though with no special application to the island, but only to the Asiatic coast in general, I may add that the chameleon, which is the subject of one of Aristotle's most perfect and minute investigations, is here comparatively common, but is not known to occur in Greece at all.

I take it then as probable, or even proven, that an important part of Aristotle's work in natural history was done upon the Asiatic coast, and in and near to Mitylene. He will be a lucky naturalist who shall go some day and spend a quiet summer by that calm lagoon, find there all the natural wealth *ὅσσον Λέσβος . . . ἐντὸς ἐέργει*, and have around his feet the creatures that Aristotle loved and knew. Moreover, it follows for certain, if all this be true, that Aristotle's biological studies preceded his more strictly philosophical work; and it is of no small importance that we should be (so far as possible) assured of this, when we speculate upon the influence of his biology on his philosophy.

Aristotle is no tyro in biology. When he writes upon mechanics or on physics, we read him with difficulty: his ways are not our ways; his explanations seem laboured; his science has an archaic look, as it were coming from another world to ours, a world before Galileo. Speaking with all diffidence, I have my doubts as to his mathematics. In spite of a certain formidable passage in the "Ethics," where we have a sort of *ethica more geometrico demonstrata*, favourite use of the equality of the angles of a triangle to four right angles, as an example of proof indisputable, in spite even of his treatise, "De Lineis Insecabilibus," I am tempted to suspect that he sometimes passed shyly beneath the superscription over Plato's door.

But he was, and is, a very great naturalist. When he treats of natural history, his language is our language, and his methods and his problems are well-nigh identical with our own. He had familiar knowledge of a thousand varied forms of life, of bird, and beast, and plant, and creeping thing: he was careful to note their least details of outward structure, and curious to probe by dissection into their parts within. He studied the metamorphoses of gnat and butterfly, and opened the bird's egg to find the mystery of incipient life in the developing chick. He recognised great problems of biology that are still ours to-day, problems of heredity, of sex, of nutrition and growth, of adaptation, of the struggle for existence, of the orderly sequence of nature's plan. Above all, he was a student of life itself. If he was a learned anatomist, a great student of the dead, still more was he a lover of the living. Evermore his world is in movement. The seed is growing, the heart beating, the frame breathing. The ways and habits of living things must be known: how they work and play, love and hate, feed and procreate, rear and tend their young; whether they dwell solitary, or in more and more organised companies and societies. All such things appeal to his imagination and his diligence. Even his anatomy becomes at once an *anatomia animata*, as Haller, poet and physiologist, was wont to describe the science to which he gave the name of physiology. This attitude towards life, such knowledge got thereby, afterwards helped to shape and mould Aristotle's philosophy.

I have no reason to suppose that the study of biology "maketh a man wise," but I am sure it helped

[1] From the Herbert Spencer lecture delivered at Oxford on February 14 by Prof. D'Arcy W. Thompson, C.B.

to lead Aristotle on the road to wisdom. Nevertheless he takes occasion to explain, or to excuse, his devotion to this study, alien, seemingly, to the pursuit of philosophy. "Doubtless," he says, "the glory of the heavenly bodies fills us with more delight than we gain from the contemplation of these lowly things; for the sun and stars are born not, neither do they decay, but are eternal and divine. But the heavens are high and afar off, and of celestial things the knowledge that our senses give us is scanty and dim. On the other hand, the living creatures are nigh at hand, and of each and all of them we may gain ample and certain knowledge if we so desire. If a statue please us, shall not the living fill us with delight; all the more if in the spirit of philosophy we search for causes and recognise the evidences of design. Then will nature's purpose and her deep-seated laws be everywhere revealed, all tending in her multitudinous work to one form or another of the beautiful." In somewhat similar words does Bacon retranslate a familiar saying: "He hath made all things beautiful according to their seasons; also he hath submitted the world to man's enquiry." On the other hand, a most distinguished philosopher of to-day is struck, and apparently perplexed, by "the awkward and grotesque, even the ludicrous and hideous forms of some plants and animals." I commend him, with all respect, to Aristotle—or to that Aristotelian verity given us in a nutshell by Rodin, "Il n'y a pas de laideur!"

To be sure, Aristotle's notion of beauty was not Rodin's. He had a philosopher's comprehension of the beautiful, as he had a great critic's knowledge and understanding of poetry; but wise and learned as he was, he was neither artist nor poet. His style seldom rises, and only in a few such passages as that which I have quoted, above its level didactic plane. Plato saw philosophy, astronomy, even mathematics, as in a vision; but Aristotle does not know this consummation of a dream. The bees have a king, with Aristotle. Had Plato told us of the kingdom of the bees, I think we should have had Shakespearian imagery. The king would have had his "officers of sorts," his magistrates, and soldiers, his "singing masons building roofs of gold." Even Pliny, arid encyclopædist as he is, can now and then throb and thrill us as Aristotle cannot do—for example, when he throws no little poetry and still more of music into his description of the nightingale's song.

But let us now come, at last, to exemplify, by a few brief citations, the nature and extent of Aristotle's zoological knowledge. Among the bloodless animals, as Aristotle called what we call the invertebrates, he distinguishes four great genera, and of these the Molluscs are one. These are the cuttle-fish, which have now surrendered their Aristotelian name of "molluscs" to that greater group, which is seen to include them, with the shellfish, or "ostracoderma" of Aristotle. These cuttle-fishes are creatures that we seldom see, but in the Mediterranean they are an article of food, and many kinds are known to the fishermen. All, or well-nigh all, of these many kinds were known to Aristotle, and his account of them has come down to us with singular completeness. He describes their form and their anatomy, their habits, their development, all with such faithful accuracy that what we can add to-day is of secondary importance. He begins with a methodical description of the general form, tells us of the body and fins, of the eight arms with their rows of suckers, of the abnormal position of the head. He points out the two long arms of Sepia and of the Calamaries, and their absence in the octopus; and he tells us, what was only confirmed of late, that with these two long arms the creature clings to the rock and sways about like a ship at anchor. He describes the great eyes, the two big teeth forming the beak; and he dissects the whole structure of the gut, with its long gullet, its round crop, its stomach, and the little coiled coccal diverticulum; dissecting not only one but several species, and noting differences that were not observed again until Cuvier re-dissected them. He describes the funnel and its relation to the mantle-sac, and the ink-bag, which he shows to be largest in Sepia of all others. And here, by the way, he seems to make one of those apparent errors that, as it happens, turn out to be justified; for he tells us that in Octopus the funnel is on the upper side, the fact being that when the creature lies prone upon the ground, with all its arms spread and flattened out, the funnel-tube (instead of being flattened out beneath the creature's prostrate body) is long enough to protrude upwards between arms and head, and to appear on one side or other thereof, in a position apparently the reverse of its natural one. He describes the character of the cuttle-bone in Sepia, and of the horny pen which takes its place in the various calamaries, and notes the lack of any similar structure in Octopus. He dissects in both sexes the reproductive organs, noting without exception all their essential and complicated parts; and he had figured these in his lost volume of anatomical diagrams. He describes the various kinds of eggs, and, with still more surprising knowledge, shows us the little embryo cuttle-fish, with its great yolk-sac, attached (in apparent contrast to the chick's) to the little creature's developing head.

But there is one other remarkable feature that he knew ages before it was rediscovered, almost in our own time. In certain male cuttle-fishes, in the breeding season, one of the arms develops in a curious fashion into a long coiled whip-lash, and in the act of breeding may then be transferred to the mantle-cavity of the female. Cuvier himself knew nothing of the nature or the function of this separated arm, and, indeed, if I am not mistaken, it was he who mistook it for a parasitic worm. But Aristotle tells us of its use and its temporary development, and of its structure in detail, and his description tallies closely with the accounts of the most recent writers.

Among the rarer species of the group he knew well the little Argonaut, with its beautiful cockle-shell, and tells how it puts up its two broad arms to sail with, a story that has been rejected by many, but that, after all, may perhaps be true.

Now in all this there is far more than a mass of fragmentary information gleaned from the fishermen. It is a plain orderly treatise, on the ways and habits, the varieties, and the anatomical structure, of an entire group. Until Cuvier wrote there was none so good, and Cuvier lacked knowledge that Aristotle possessed.

As exact and scarce less copious is the chapter in which Aristotle deals with the crab and lobster, and all such crustacean shell-fish, and that in which he treats of insects, after their kind. Most wonderful of all, perhaps, are those portions of his books in which he speaks of fishes, their diversities, their structure, their wanderings, and their food. Here we may read of fishes that have only recently been rediscovered,[2] of structures only lately re-investigated, of habits only of late made known.[3] And many such anticipations of our knowledge, and many allusions to things of which perhaps we are still ignorant, may yet be brought to light; for we are still far from having

[2] *E.g. Parasilurus aristotelis*, a siluroid fish of the Achelous.
[3] *E.g.* the reproduction of the pipe-fishes (Syngnathi), the hermaphrodite nature of the Serrani, the nest-building of the wrasses, &c.

interpreted and elucidated the whole mass of Aristotle's recorded erudition, which whole recorded mass is only, after all, *tanquam tabula naufragii.*

There is perhaps no chapter in the "Historia Animalium" more attractive to the anatomist than one which deals with the anatomy and mode of reproduction of the cartilaginous fishes, the sharks and rays, a chapter which moved to admiration that prince of anatomists Johannes Müller.[4] The latter wrote a volume on the text of a page of Aristotle, a page packed full of a multitude of facts, in no one of which did Johannes Müller discover a flaw. The subject is technical, but the gist of the matter is this: that among these Selachians (as, after Aristotle, we still sometimes call them) there are many diversities in the structure of the parts in question, and several distinct modes in which the young are brought forth or matured. For in many kinds an egg is laid, which eggs, by the way, Aristotle describes with great minuteness. Other kinds do not lay eggs, but bring forth their young alive, and those include the torpedo and numerous sharks or dogfish. The eggshell is in these cases very thin, and breaks before the birth of the young. But among them there are a couple of sharks, of which one species was within Aristotle's reach, where a very curious thing happens. Through the delicate membrane, which is all that is left of the eggshell, the great yolk-sac of the embryo becomes connected with the parental tissues, which infold and interweave with it; and by means of this temporary union the blood of the parent becomes the medium of nourishment for the young. And the whole arrangement is physiologically identical with what obtains in the higher animals, the mammals, or warm-blooded vivipara. It is true that the yolk-sac is not identical with that other embryonic membrane which comes in the mammals to discharge the function of which I speak; but Aristotle was aware of the difference, and distinguishes the two membranes with truth and accuracy.

It happens that of the particular genus of sharks to which this one belongs, there are two species differing by almost imperceptible characters; but it is in one only of the two, the *γαλεὸς λεῖος* of Aristotle, that this singular phenomenon of the *placenta vitellina* is found. It is found in the great blue shark of the Atlantic and the Mediterranean; but this creature has grown to a very large size before it breeds, and such great specimens are not likely to have come under Aristotle's hands. Cuvier detected the phenomenon in the blue shark, but paid little attention to it, and for all his knowledge of Aristotle, did not perceive that he was dealing with an important fact which the philosopher had studied and explained. In the seventeenth century, the anatomist Steno actually rediscovered the phenomenon, in the *γαλεὸς λεῖος*, the *Mustela laevis* itself, but he was unacquainted with Aristotle. And the very fact was again forgotten until Johannes Müller brought it to light, and showed not only how complete was Aristotle's account, but how wide must have been his survey of this class of fishes to enable him to record this peculiarity in its relation to their many differences of structure and reproductive habit. I used to think of this phenomenon as one that Aristotle might have learned from the fishermen, but after a more careful study of Johannes Müller's book, I am convinced that this is not the case. It was a discovery that could only have been made by a skilled and learned anatomist.

In a lengthy and beautiful account Aristotle describes the development of the chick. It is on the third day that the embryo becomes sufficiently formed for the modern student to begin its study, and it was after just three days (a little earlier, as Aristotle notes, in little birds, a little later in larger ones) that Aristotle saw the first clear indication of the embryo. Like a speck of blood, he saw the heart beating, and its two umbilical blood-vessels breaking out over the yolk. A little later he saw the whole form of the body, noting the disproportionate size of head and eyes, and found the two sets of blood-vessels leading, the one to the yolk-sac, the other to the new-formed allantois. In the tiny chick of the tenth day, he saw the stomach and other viscera; he noted the altered position of the heart and great blood-vessels; he traced clearly and fully the surrounding membranes; he opened the little eye, to seek, but failed to find, the lens. And at length he describes in detail the appearance and attitude of the little chick, the absorption of the yolk, the shrivelling of the membranes, just at the time when the little bird begins to chip the shell, and before it steps out into the world. While this account contains but a part of what Aristotle saw (and without a lens it would be hard to see more than he), it includes the notable fact of the early appearance of the heart, the *punctum saliens* of later writers, whose precedence of all other organs was a chief reason for Aristotle's attributing to it a common, central, or primary sense, and so locating in it the central seat of the soul. And so it was held to be until Harvey's time, who, noting the contemporaneous appearance of heart and blood, held that the contained was nobler than that which contained it, and that it was the blood that was "the fountain of life, the first to live, the last to die, the primary seat of the soul, the element in which, as in a fountain-head, the heat first and most abounds and flourishes"; so harking back to a physiology more ancient than Aristotle's—"for the blood is the life thereof." All students of the "Timaeus" know that here Aristotle parted company with Plato, who, following Hippocrates and Democritus, and others, placed the seat of sensation, the sovereign part of the soul, in the brain. Right or wrong, it was on observation, and on his rarer use of experiment,[5] that Aristotle depended. The wasp or the centipede still lives when either head or tail is amputated, the tortoise's heart beats when removed from the body, and the heart is the centre from which the blood-vessels spring. To these arguments Aristotle added the more idealistic belief that the seat of the soul, the ruling force of the body, must appropriately lie in the centre; and he found further confirmation of this view from a study of the embryo plant, where in the centre, between the seed-leaves, is the point from which stem and root grow. And Ogle reminds us how, until a hundred years ago, botanists still retained an affectionate and superstitious regard for that portion of the plant, calling it now *cor*, now *cerebrum*, the plant's heart or brain.

And now is it possible to trace directly the influence of Aristotle's scientific training and biological learning upon his sociology, his psychology, or in general on his philosophy? That such an influence must have been at work is, *prima facie*, obvious. The physician who becomes a philosopher will remain a physician to the end; the engineer will remain an engineer; and the ideas of pure mathematics, Roger Bacon's "alphabet of philosophy," will find issue and expression in the philosophy of such mathematicians as

[4] *Cf.* Cavolini, in his classical 'Mem. sulla Generazione dei Pesci," Naples, 1787: "E quando io . . . scorro la Storia degli Animali di Aristotile, non posso non essere da stupore preso, in esse leggende veduti quei fatti, che a noi non si son potuti che a stento manifestare: e rilevati poi con tutta la nettezza, e posti in parallelo coi fatti già riconosciuti nel feto del gallo;" &c.

[5] Aristotle's experiments were akin to Voltaire's, who employed himself in his garden at Ferney in cutting off the horns and heads of snails, to see whether, or how far, they grew again.

Plato, Leibnitz, Spinoza, or Descartes. Moreover, it is not only the special training or prior avocation of the philosopher that so affects his mind. In divers historical periods the rapid progress or the diffused study of a particular science has moulded the philosophy of the time. So on a great scale in the present day does biology; so did an earlier phase of evolutionary biology affect Hegel; and in like manner, in the great days of Dalton and Lavoisier, did chemistry help, according to John Stuart Mill, to suggest a "chemistry of the mind" to the "association" psychologists? A certain philosopher,[6] in dealing with this theme, begins by telling us that "Mathematics was the only science that had outgrown its merest infancy among the Greeks." Now it is my particular purpose to-day to show, from Aristotle, that this is not the case. Whether Aristotle's biological forerunners were many or few, whether or not the Hippocratics (for instance) had failed to raise physiology and anatomy to the dignity of a science, or, having done so, had only reserved them, as a secret cult, to their own guild; in short, whether Aristotle's knowledge is in the main the outcome of his solitary labours, or whether, as Leibnitz said of Descartes, *praeclare in rem suam vertit aliorum cogitata,* it is at least certain that biology was in *his* hands a true and comprehensive science only second to the mathematics of his age.

The influence, then, of scientific study, and in particular of biology, is not far to seek in Aristotle's case. It has ever since been a course or plan to compare the State, the body politic, with an organism, but it was Aristotle who first employed the metaphor. Again, in his exhaustive accumulation and treatment of facts, his method is that of the observer, of the scientific student, and is in the main inductive. Just as, in order to understand fishes, he gathered all kinds together, recording their forms, their structure, and their habits, so he did with the constitutions of cities and of States. Those two hundred and more πολιτεῖαι which Aristotle laboriously compiled, after a method of which Plato would never have dreamed, were to form a natural history of constitutions and governments. And if we see in his concrete, objective treatment of the theme a kinship with Spencer's descriptive sociology, again, I think, a difference is soon apparent between Spencer's colder catalogue of facts and Aristotle's more loving insight into the doings and into the hearts, into the motives and the ambitions, of men.

But whatever else Aristotle is, he is the great Vitalist, the student of the body with the life thereof, the historian of the soul.

Now we have already seen how and where Aristotle fixed the soul's seat and local habitation. But the soul has furthermore to be studied according to its attributes, or analysed into its "parts." Its attributes can be variously analysed, as in his "Ethics" Aristotle shows. But it is in the light of biology alone that what amounts to a scientific analysis, such as is developed in the "De Anima," becomes possible; and in that treatise, it is only after a long preliminary physiological discussion that Aristotle at length formulates his distinctive psychology. There is a principle of continuity, a συνέχεια that runs through the scale of structure in living things, and so, little by little, by imperceptible steps, does nature make the passage from plant, through animal, to man: it is with all the knowledge summarised in a great passage of the "Natural History," and embodied in this broad generalisation, that he afterwards proceeds to indicate the same gradation in psychology, and to draw from it a kindred classification of the soul.

[6] Ritchie, "Darwin and Hegel," p. 39.

But observe that, though Aristotle follows the comparative method, and ends by tracing in the lower forms the phenomena incipient in the higher, he does not adopt the method so familiar to us all, on which Spencer insisted, of first dealing with the lowest, and of studying in successive chronological order the succession of higher forms. The historical method, the realistic method of the nineteenth century, the method to which we insistently cling, is not the only one. Indeed, even in modern biology, if we compare, for instance, the embryology of to-day with that of thirty years ago, we shall see that the pure historical method is relaxing something of its fascination and its hold. Rather has Aristotle continually in mind the highest of organisms, in the light of the integral and constituent phenomena of which must the less perfect be understood. So was it with one whom the Lord Chancellor of England has called "the greatest master of abstract thought since Aristotle died." For Hegel, as I feel sure for Aristotle, *Entwicklung* was not a "time-process but a thought-process." To Hegel, an actual, realistic, outward, historical evolution seemed but a clumsy and materialistic philosophy of nature. In a sense, the "time-difference has no interest for thought." And if the lower animals help us to understand ourselves, it is in a light reflected from the study of man.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—At a meeting of the electors to the Plumian professorship of astronomy held on April 19 Mr. A. S. Eddington, chief assistant at the Royal Observatory, Greenwich, was elected into the professorship, in succession to the late Sir George Darwin.

The adjudicators of the Adams Prize for the period 1911–12 consider that the two essays submitted to them with the following titles are of distinction: "The Theory of Radiation," by Mr. S. B. McLaren, and "The Fundamental Spectra of Astrophysics," by Dr. J. W. Nicholson, between whom the prize is divided in equal shares.

OXFORD.—The Romanes lecture will be delivered on Thursday, May 8, at 3 p.m., by Sir W. M. Ramsay. The subject is "The Imperial Peace: an Ideal Pervading European History."

The Halley lecture will be delivered on Thursday, May 22, at 8.30 p.m., by Dr. Louis A. Bauer, of the Carnegie Institution of Washington, U.S.A. Subject, "The Earth's Magnetism." The lecture will be illustrated by lantern slides.

On Tuesday, April 22, Convocation authorised the expenditure of a sum not exceeding 6000*l*. for the erection of additional buildings forming an extension of the School of Rural Economy. The money will be provided partly by a grant from the Development Fund of the Treasury, and partly out of the sum presented to the University in 1912 by Mr. Walter Morrison for the promotion of the study of agriculture.

UNDER the title *Educação*, a new fortnightly twelve-page magazine has been started in Portugal, dealing with elementary education, and we have now received the current issues, which commence with January. It contains original articles and reviews, an interesting feature being the series of experiments in elementary physics classed under two categories, namely experiments performed with simple apparatus (such as coffee-pots, kitchen utensils, and the like) and experiments suited for a laboratory.

The seventeenth annual conference of the Parents' National Educational Union will be held at the Caxton Hall, Victoria Street, S.W., on May 5. Among the subjects of papers are:—Education and social sympathy, J. St. G. Heath; the reading habit and a wide curriculum, Miss C. M. Mason; knowledge and learning, Stanley Leathes, C.B.; and knowledge and its relation to national efficiency, J. L. Paton. Further particulars may be obtained from Miss Parish, 26 Victoria Street, S.W.

The University of Edinburgh announces the establishment, in October next, of a mathematical laboratory for practical instruction in numerical, graphical, and mechanical calculation and analysis, as required in applied mathematical sciences and for research in connection with the mathematical department. A course of practical work has been drawn up by Prof. E. T. Whittaker, F.R.S., including methods of interpolation, graphic solution of equations, practical Fourier analysis, use of calculating instruments, and calculations of elliptic functions, Bessel functions, gamma functions, and, indeed, new functions not previously tabulated. Prof. Whittaker proposes to give sufficient theoretical explanation to render the more advanced work intelligible to those who have not previously studied the functions of higher analysis.

The Board of Agriculture and Fisheries proposes to award in October next twelve research scholarships in agricultural science, of the annual value of 150*l.*, and tenable for three years. These scholarships have been established in order to train promising students under suitable supervision, with the view of their contributing to the development of agriculture, either by carrying out independent research, or by acting in an advisory capacity to agriculturists. They will be granted only to students who show distinct promise of capacity for advanced study and research in some one of the sciences bearing on agriculture. Applicants must be graduates of a university, or holders of a diploma of a university or college of university rank, and application should be made not later than June 9 on a form to be obtained from the secretary, Board of Agriculture and Fisheries, Whitehall Place, London, S.W.

The annual conference of the Association of Teachers in Technical Institutions will be held this year in Bradford at Whitsuntide. The proceedings will be opened on Whit-Monday, when the Lord Mayor of Bradford, Alderman Fred Foster, will officially welcome the conference to Bradford. This will be followed by the address of the president, Mr. P. Coleman, of the Northern Polytechnic Institute. The meeting on Tuesday evening will be addressed by the Right Hon. J. A. Pease, President of the Board of Education, and in view of the introduction of the new Education Bill soon after Whitsuntide, this address will be looked forward to with exceptional interest. This meeting will also be addressed by Dr. M. E. Sadler, Vice-Chancellor of the University of Leeds, Sir William Priestley, M.P., Sir Alfred Keogh, K.C.B., rector of the Imperial College of Science and Technology, Mr. F. W. Jowett, M.P., and others. Papers will be read to the conference on corporate life in a technical institution, by Mr. W. Hibbert, the Polytechnic, Regent Street; vocational education, by Mr. A. C. Coffin, director of education, Bradford, and coordination within a county area, by Mr. F. N. Cook, secretary for higher education in the West Riding of Yorkshire.

The January issue of the Bulletin of the Massachusetts Institute of Technology contains the report of the president, Dr. R. C. Maclaurin, presented to the governing body of the institute in December last. Taken in conjunction with that of the previous year, the report shows that during the last eighteen months nearly 1,400,000*l.* has been paid or promised by way of gift to the Massachusetts Institute of Technology. The principal items include 600,000*l.* for buildings, 160,000*l.* for land, 320,000*l.* for general endowment, 150,000*l.* for endowment of the department of naval architecture, 40,000*l.* for scientific research, and 100,000*l.* for scholarships. It is not surprising to find that the institute attracts students from all parts of the United States, and, indeed, from all parts of the world. Students come in large numbers from China, South America, Canada, and in considerable numbers from Europe, India, Egypt, South Africa, and a few from Australia. The proportion of foreign students at the institute is more than double that at almost any other institution in the United States. The number of students on November 1 last reached 1611, the largest in the history of the institute. The total number of members of the teaching staff for these students was 254, of whom 56 were full professors, while there were, in addition, 16 research professors.

SOCIETIES AND ACADEMIES.

Royal Society, April 17.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. W. **Watson**: The luminosity curves of persons having normal and abnormal colour vision. The author has calculated the form of the luminosity curves corresponding to different degrees of deficiency of the red and green sensation, and shows that in the great majority of cases of colour blindness the observed points agree with the calculated curves, and hence the correctness of Sir W. Abney's sensation curves and his theory as to partial colour blindness is supported. The cases of abnormal luminosity curves given by persons having normal colour vision are shown to be probably due to variation in macular pigmentation.—Prof. W. H. **Bragg** and W. L. **Bragg**: The reflection of X-rays by crystals. The paper deals with the reflection of a beam of X-rays by the cleavage faces of various crystals, an ionisation method being employed to measure the strength of the reflected rays. The apparatus corresponds to a spectrometer, the parallel planes in which the atoms of the crystal are arranged taking the place of the lines of a grating, and the ionisation chamber that of a telescope. A fine slit in front of the X-ray bulb allows a beam of rays to fall on the face of the crystal, and both crystal and ionisation chamber turn about the axis of the instrument and can be set at any desired angles. By this method evidence has been found of the existence of three very homogeneous components in the rays from the bulb employed, which are only reflected from the crystal at definite angles. They show as a very strong reflection superimposed on the general reflection which takes place at all angles. Each of these has a definite absorption coefficient in aluminium, and can be recognised when reflected from many crystals. The absorption of the homogeneous rays in different metals corresponds in all respects to the absorption of characteristic X-rays.—Prof. J. C. **McLennan**: A fluorescence spectrum of iodine vapour.—Dr. W. **Wahl**: The relation between the crystal-symmetry of the simpler organic compounds and their molecular constitution. Part I.—Prof. H. E. **Armstrong** and E. E. **Walker**: Studies of the processes operative in solutions. XXVIII., The causes of variation in the optical rotatory power of organic compounds and of anomalous rotatory dispersive power. Attention is directed to the explanation of the anomalous rotatory dispersive power displayed by some organic compounds, notably, the tartrates, which was given by Biot, the original discoverer of optical rotatory power, viz. that it may be due to the presence of two compounds of opposite rotatory power (+ and −) differing in rotatory dispersive power. This explanation appears to have been generally overlooked. The behaviour to be expected of compounds varying in their optical properties in different ways is discussed. The results arrived at serve to explain the apparently abnormal variation in optical behaviour often noticed in optically active compounds; they also appear to be of significance as indicating a relation among solvents generally and underlying their action towards substances generally of a very definite and regular character; each solvent would seem to have its definite sphere and mode of action, so that any two solvents behave relatively always in the same way towards solutes generally, apart from the exceptional cases in which some special property of the solute comes into operation to disturb regularity of action.

Geological Society, April 9.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—Dr. G. **Hickling**: The variation of *Planorbis multiformis*, Bronn. The writer gives an account of an investigation of the above-named Miocene gasteropod, based on a suite of 532 specimens from a single block of stone. A study was made of the variation in height presented by the shells, which include every gradation between perfectly discoid forms and types with a spire the height of which considerably exceeds the diameter of the base. By sorting the whole of the shells into ten grades, according to height, it was shown that forms of mean height were common, while extreme forms were rare, the height being distributed, in fact, according to a typical "variation-curve." If more than one species were really present, it is in the highest degree improbable that the various types should be distributed in the proportions actually found, and this is taken as the most satisfactory proof possible of the specific unity of the group. It is shown that the shells also vary extensively in respect of the amount of carination, the degree of involution, the form of cross-section of the whorls, the form of aperture, and the stage of development at which various characters are acquired, the variation in each character being, however, "continuous."—Miss M. Colley **March**: The structure and relationships of the Carbonicolæ. The evidence for the relationship of the Carbonicolæ to the Unionidæ, based on shell-structure, muscle-scars, form, habitat, ligament, and hinge-teeth, appears insufficient.

Physical Society, April 11.—Prof. C. H. Lees, F.R.S., vice-president, in the chair.—A. **Campbell** and H. C. **Booth**: Errors in magnetic testing due to elastic strain. In magnetic tests on sheet material considerable errors may occur if the sheets or strips are tested while in bent form. These errors, which are in general agreement with the known effects of compression and tension, were investigated experimentally with one or two forms of magnetic circuit similar to those sometimes occurring in practice.—Dr. G. W. C. **Kaye**: Note on kathodic sputtering. The paper gives an account of the volatilisation of an aluminium kathode in a discharge tube containing helium. The sputtered deposit on the glass indicates that, under the conditions which prevailed, the disintegration was restricted to the edges of the kathode and did not occur elsewhere. Accordingly the complete outline of the kathode (made by rolling a sheet of aluminium into a nearly complete cylinder) was traced out by the deposit on the walls of the tube.—A. **Campbell**: Vibration galvanometers with unifilar torsional control. The author exhibited a moving-coil vibration galvanometer in which a novel principle is used to obtain the fine adjustment of the control torque requisite for accurate tuning.

DUBLIN.

Royal Dublin Society, April 15.—Dr. James H. Pollok in the chair.—Prof. H. H. **Dixon** and W. R. G. **Atkins**: Extraction of zymase by freezing. Yeast frozen solid by exposure to liquid air, and centrifuged when thawed, gives up its sap. The sap thus extracted amounts to about one-third of the volume of the yeast originally treated. It is free from fermentable carbohydrates, but actively ferments cane-sugar when supplied to it. Its activity, in the samples examined, was as great as that of the extract prepared from the same samples by Lebedeff's maceration method. The method of extraction by means of liquid air has the advantage of great rapidity. Culture experiments show that the yeast is killed by exposure to the temperature of liquid air.—Prof. H. H. **Dixon** and W. R. G. **Atkins**: Osmotic pressures in plant organs. III., The osmotic pressure and electrical conductivity of yeast, beer, and wort. Measurements of osmotic pressure were made by the thermo-electric method of cryoscopy previously described. The yeast juice was obtained by freezing the yeast in liquid air and centrifuging the resultant liquid mass. It was found that ordinary yeast has an osmotic pressure of about 41 atm., that of wort being about 14. Thus there is a marked rise in pressure during fermentation. The impermeability of the yeast cell to electrolytes is shown by the conductivity of the juice being about four times as great as that of the beer, which is practically the same as that of the unfermented wort. Both the osmotic pressure and electrical conductivity of pressed yeast are greater than is the case in actively fermenting yeast.—R. Lloyd **Praeger**: The buoyancy of the seeds of some Britannic plants. The importance of the question of the buoyancy of seeds in water in connection with the dispersal and distribution of plants has been long recognised. The experiments of Darwin, Martins, Thuret, and Guppy lead to the generalisation that only about one-tenth of a flora bear seeds capable of more than a very brief period of buoyancy. The present experiments were undertaken in order to furnish further data for a study of the dispersal of our native species. Hitherto results were available for about 330 native species. The number of species tested is now raised to 900. The results bear out the conclusion already mentioned; also Guppy's conclusion that the buoyant seeds belong mainly to maritime and marsh species. Some results relating to fresh and dried fleshy fruits and also to fruiting branches are given.

PARIS.

Academy of Sciences, April 14.—M. F. Guyon in the chair.—Emile **Picard**: Application of the theory of integral equations to certain problems in the analytical theory of heat on the hypothesis of a sudden rise of temperature at the surface of separation of the bodies in contact.—J. **Boussinesq**: The velocity of slow fall of a liquid spherical drop, after becoming uniform, in a viscous liquid of slightly greater density than the falling drop.—M. **Landouzy** was elected a member of the section of free academicians in the place of the late M. Teisserenc de Bort.—G. de **Saint-Aubin**: An apparatus allowing of a variation of the carrying surface of an aëroplane. The apparatus consists of two auxiliary planes with surfaces of slight curvature, with their centres of sustentation for a given angle of attack on the same line passing through the centre of sustentation of the ordinary planes of the aëroplane. J. **Guillaume**: Observations of the sun made at the

Observatory of Lyons during the fourth quarter of 1912. Tables are given of the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude. Observations were possible on fifty-nine days.—J. **Lagrula**: A new method for the rapid visual search for the small planets. The method is based on the application of binocular vision, combined with the use of a coloured screen. The presence of a small planet in the field can be proved in less than a minute. An error of position of the asteroid 233, Asterope, was detected on the night of April 1 in less than five minutes.—M. **Tzitzéica**: A generalisation of non-Euclidean minimal surfaces.—G. **Valiron**: Integral functions of finite order.—Georges **Rémoundos**: The series and families of algebroid functions in a domain.—G. **Pólya**: The method of Graeffe.—M. **Gunther**: The characteristics of systems of partial differential equations.—Albert **Turpain**: The reception in the Morse code of radio-telegrams with simultaneous photographic record. Diagrams showing the results obtained by the system of relays described in an earlier communication (March 17).—M. de **Broglie**: The reflection of the Röntgen rays. Reproductions of photographs obtained by the reflection of Röntgen rays by various crystals at a grazing angle. The exact interpretation of the results is still uncertain.—H. **Guilleminot**: The variation of the electrical resistance of selenium when irradiated by the Röntgen rays and by radium rays. The results are given in a table showing the fall of resistance of a selenium cell under the action of the X-rays; a preliminary study of the effects of varying voltage and temperature was necessary. Similar measurements were made with exposure to radium rays, but the results are not given.—Camille **Matignon**: The reduction of magnesia by aluminium. A mixture of aluminium powder and magnesia, heated to 1200° C. in a vacuous steel tube, the upper portion of which was kept cool, gave metallic magnesium as crystals in the cold portion. The yield of magnesium was good.—L. C. **Maillard**: The formation of humus by the action of polypeptides on sugars.—Paul **Gaubert**: The polymorphism of codeine, thebaine, and narcotine. A new type of sphærolite.—L. **Collot**: The celestine of the sedimentary strata.—G. **André**: The evolution of the mineral and nitrogenous materials in some annual plants.—F. **Baco**: Comparative budding of grafted and ungrafted vines.—Jules **Glover**: An intensive physiological telephone. The action of the current on the receiving magnet of the telephone does not depend on its strength so much as on the variations in strength. The new arrangement described is based on the study of the physiological causes of these variations.—B. **Roussy**: The mathematical theory of the geometric law of the surface of the human body. The body is pictured as consisting of twenty-six truncated cones and a formula derived for obtaining the true surface. Various approximations are discussed.—Raphaël **Dubois**: Microzymas, coccoliths, and vacuolids.—Charles **Nicolle**, A. **Cuénod**, and L. **Blaizot**: Some properties of the virus of trachoma. Immunity in trachoma. The Algerian ape (*Macacus inuus*) contracts trachoma, but throws off the disease completely in from one to three months. Immunisation experiments were carried out on this animal with successful results; results of the application of similar treatment to man are also given.—Charles **Lepierre**: The replacement of zinc by uranium in the culture of *Aspergillus niger*. Uranium can replace zinc in Raulin's fluid; the stimulation of growth of the mould is less intense, however, with uranium than with zinc.—E. **Voisenet**: New researches on a ferment of bitter wines. A bacillus has been isolated, named *Bacillus amaracrylus*, which produces all the characteristics of bitterness in wines. It converts glycerol partially into acrolein, to which the bitter taste is due, the other products formed including hydrogen, carbon dioxide, ethyl alcohol, and various fatty acids.—M. **Piettre** and A. **Vila**: The preparation of fibrinogen by dialysis on saccharose syrup.—L. **Cayeux**: The sedimentary iron minerals considered in their relations with the destruction of mountain chains.—I. **Assada**: The levels of the Lyons plateau.—M. **Durand-Gréville**: The laws relating to wind-storms causing a kink in the barometric chart.—De Montessus de **Ballore**: Destructive earthquakes and atmospheric precipitations.

Calcutta.

Asiatic Society of Bengal, April 2.—R. **Gurney**: Entomostraca from Lake Tiberias. Dr. Annandale obtained eight species of Entomostraca in the Lake of Tiberias and in small pools near it. Eight other species were bred from earth taken from a dried-up pool between Tiberias and Nazareth. The collection does not comprise any forms hitherto unknown.—D. **Hooper**: Sarcocolla. This is a description of a drug known to the early Greek and Arabian physicians, and used largely in India. It is the gum of *Astragalus fasiculifolius*, Buissier, a spiny shrub growing in Persia. Chemical examination shows that it consists principally of a peculiar glucoside differing from saponin and glycyrrhizin.

BOOKS RECEIVED.

Bulletin International. Résumés des Travaux Présentés. Classe des Sciences Mathématiques, Naturelles et de la Médecine. xvii[e] Année. Pp. iii+419+plates. (Prague: L'Académie de Sciences de l'Empereur François Joseph.)

Icones Plantarum Formosanarum nec non et Contributiones ad Floram Formosanam, or Icones of the Plants of Formosa, and Materials for a Flora of the Island, based on a Study of the Collections of the Botanical Survey of the Government of Formosa. By B. Hayata. Fasc. ii. Pp. ii+156+xl plates. (Taihoku: Bureau of Productive Industries, Government of Formosa.)

Reprints of Papers from the Science Laboratories of the University of Sydney, 1908–9 to 1911–12. (Sydney.)

A Manual of Agricultural Chemistry. By H. Ingle. Third edition. Pp. 397. (London: Scott, Greenwood and Son.) 7*s*. 6*d*. net.

The Fauna of British India, including Ceylon and Burma. Hymenoptera. Vol. iii. By C. Morley. Pp. xxxvi+531+1 plate. (London: Taylor and Francis.) 20*s*.

Nomography, or the Graphic Representation of Formulæ. By Capt. R. K. Hezlet. Pp. iv+54. (Woolwich: Royal Artillery Institution.) 2*s*. 6*d*.

A Handbook of Forestry. By W. F. A. Hudson. Pp. ix+82. (Watford: Cooper Laboratory for Economic Research.) 2*s*. 6*d*. net.

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft. 95 Jahresversammlung vom 8–11 September 1912 in Altdorf. Teil I. Pp. vii+210+171+plates. Teil II. Pp. vii+251+2 plates. (Aarau: H. R. Sauerländer et Cie.)

The Works of Aristotle, translated into English. De Coloribus. By T. Loveday and E. S. Forster. (Oxford: Clarendon Press.) 5*s*. net.

A Manual of Petrology. By F. P. Mennell. Pp. iv+256. (London: Chapman and Hall, Ltd.) 7*s*. 6*d*. net.

The Conquest of Bread. By P. Kropotkin. Cheap edition. Pp. xvi+298. (London: Chapman and Hall, Ltd.) 1s. net.

Elementary Experimental Dynamics for Schools. By C. E. Ashford. Pp. viii+246. (Cambridge University Press.) 4s.

Vegetation of the Peak District. By Dr. C. E. Moss. Pp. x+235+plates. (Cambridge University Press.) 12s. net.

Die gnomonische Projektion in ihrer Anwendung auf kristallographische Aufgaben. By Dr. H. E. Boeke. Pp. iv+54. (Berlin: Gebrüder Borntraeger.) 3.50 marks.

Die Rehobother Bastards und das Bastardierungsproblem beim Menschen. By Dr. E. Fischer. Pp. vii+327+19 plates. (Jena: G. Fischer.) 16 marks.

E. Strasburger. Das botanische Praktikum. Fünfte Auflage. By Drs. E. Strasburger and M. Koernicke. Pp. xxvi+860. (Jena: G. Fischer.) 24 marks.

Proceedings of the London Mathematical Society. Second series. Vol. xi. Pp. xlviii+482. (London: F. Hodgson.)

IV^e Conférence Internationale de Génétique, Paris, 1911. Comptes rendus et rapports. Edited by P. de Vilmorin. Pp. x+571. (Paris: Masson et Cie.) 25 francs.

Elementary Practical Mathematics. By Prof. J. Perry. Pp. xiv+335. (London: Macmillan and Co., Ltd.) 6s.

DIARY OF SOCIETIES.

THURSDAY, APRIL 24.

ROYAL SOCIETY, at 4.30.—(1) Protostigmata in Ascidians; (2) The Origin of the Ascidian Mouth: A. G. Huntsman.—Experiments on the Kidneys of the Frog: F. A. Bainbridge, S. H. Collins, and J. A. Menzies.—(1) The Probable Value to *Bacillus coli* of "Slime" Formation in Soils; (2) Variation in *B. coli*. The Production of Two Permanent Varieties from One Original Strain by Means of Brilliant Green: Cecil Revis.

ROYAL INSTITUTION, at 3.—The Progress of Hittite Studies. II. Religious Monuments of Asia Minor: Prof. J. Garstang.

SOCIETY OF DYERS AND COLOURISTS (London Section), at 8.—The Chemistry of the Vat Dyes: E. de B. Barnett.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Phase-Advancing: Dr. G. Kapp.

CONCRETE INSTITUTE, at 7.30.—Discussion on Reports of the Science Standing Committee on: (1) A Standard Notation for Structural Engineering Calculations; (2) A Standard Specification for Reinforced Concrete Work; (3) Standard Connections and Joints in Reinforced Concrete.

FRIDAY, APRIL 25.

ROYAL INSTITUTION, at 9.—Meroë: Four Years' Excavations of the Ancient Ethiopian Capital: Prof. J. Garstang.

PHYSICAL SOCIETY, at 5.—A Graphic Method of Optical Imagery: W. R. Bower.—Spectroscopic Resolution of a Graph: Dr. C. V. Burton.—Some Experiments to Detect β-rays from Radium-A: Dr. W. Makower and Dr. S. Russ.

MONDAY, APRIL 28.

ROYAL SOCIETY OF ARTS, at 8.—Antiseptics and Disinfectants. II.: Dr. D. Sommerville.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—400th Anniversary of the Discovery of the Pacific Ocean by Blasco Nunez de Balboa: Sir Clements R. Markham, K.C.B.

INSTITUTE OF ACTUARIES, at 5.—An Investigation into the Effects of Family and Personal History upon the Rates of Mortality Experienced in Various Classes of Life Assurance Risks, with Special Reference to Tuberculosis: E. A. Rusher and C. W. Kenchington.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Law in Relation to Engineering: T. F. Thomson.

TUESDAY, APRIL 29.

ROYAL INSTITUTION, at 3.—Recent Physiological Inquiries. I. Motion and Locomotion: Prof. W. Stirling.

ILLUMINATING ENGINEERING SOCIETY, at 7.30.—*Discussion*: Standard Clauses for Inclusion in a Specification of Street-lighting: A. P. Trotter.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Annual General Meeting.

WEDNESDAY, APRIL 30.

ROYAL SOCIETY OF ARTS, at 8.—The Science Museum: Dr. F. G. Ogilvie.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.—The Spectra of Comets: Prof. A. Fowler.—A Popular Star Finder: G. F. Chambers.—Seeing: J. W. Worthington.

THURSDAY, MAY 1.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Capacity for Heat of Metals at Different Temperatures: Dr. E. H. Griffiths and Ezer Griffiths.—The Transition from the Elastic to the Plastic State in Mild Steel: A. Robertson and G. Cook.—Studies of the Processes Operative in Solutions XXVIII. The Influence of Acids on the Rotatory Power of Cane Sugar, of Glucose and of Fructose: F. P. Worley.—The Attainment of High Potentials by the Use of Radium: H. G. J. Moseley.—The Decrease in Velocity of α Particles in passing through Matter: E. Marsden and Dr. T. S. Taylor.

ROYAL INSTITUTION, at 3.—The Progress of Hittite Studies. III. Cults of Northern Syria: Prof. J. Garstang.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Use of the Electrostatic System for the Measurement of Power: C. C. Paterson, E. H. Rayner, and A. Kinnes.

LINNEAN SOCIETY, at 8.—The Structure of the Wood of East Indian Species of Pinus: Prof. P. Groom and W. Rushton.—Branching Specimens of *Lyginodendron oldhamium*, Will.: Dr. Winifred Brenchley.—A Problem in Weismannism: A. C. F. Morgan.—Note on *Sphenopus marsupialis*: Mrs. L. J. Wilsmore.—Polychæta of the Indian Ocean, with some Species from the Cape Verde Islands—The Serpulidæ, with a Classification of the Genera Hydroides and Eupomatus: Miss Helen L. M. Pixell.—Report on the Arachnida of the Seychelles: S. Hirst.—*Gypsina plana*, Carter: Miss Marjorie Lindsay.—Nitidulæ, Heterocidæ: A. Grouvelle.—Pselaphidæ de l'Archipel des Seychelles: A. Raffray.—Anthribidæ of the Seychelles: Dr. K. Jordan.—Hispinæ from the Seychelles: S. Maulik.

FRIDAY, MAY 2.

ROYAL INSTITUTION, at 9.—Blood Parasites: H. G. Plimmer.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2270, Vol. 91] THURSDAY, MAY 1, 1913 [Price Sixpence

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THURSDAY, MAY 1, 1913.

THE CARBONISATION OF COAL.

The Carbonisation of Coal. A Scientific Review of the Formation, Composition and Destructive Distillation of Coal for Gas, Coke and By-Products. By Prof. V. B. Lewes. Pp. xiv+315. (London: John Allan and Co., 1912.) Price 7s. 6d. net.

THIS book is a welcome addition to the literature of a subject which is increasing in importance with each successive decade. Practical men are at length beginning to realise that the utilisation of the store of potential energy in coal by more rational methods than have hitherto prevailed is a problem that has to be grappled with seriously if our supremacy in the chief manufactured products of the world is to be maintained Authorities of the highest competence have repeatedly pointed out that enormous economies might be effected if more scientific—that is, more common-sense—methods were employed in the consumption of coal. The waste is universal and extends practically to every industry, although in some to a much greater extent than in others. In the blast furnaces it is relatively small, for the reason that ever since the introduction of the hot-blast, the connection between potential energy and output has received an amount of consideration such as has not been bestowed upon any other aspect of the general problem. On railways, in factories, in brickworks, potteries and glassworks the waste is simply appalling.

It has been calculated that our annual consumption of coal is from 143 to 168 million tons per annum, of which from 30 to 36 million tons are used for domestic purposes. Of this huge amount it is estimated that from 40 to 60 million tons are practically wasted; that is, this quantity could be saved if gas-generating plant, electric motor and traction, gas heating and gas cooking, briquettes and coke were more generally employed than they are at present.

We think, therefore, that Prof. Lewes has been amply justified in putting together and in enlarging his Cantor lectures on the carbonisation of coal, given to the Society of Arts in 1911, and we trust that his appeal to a wider public will meet with the success it undoubtedly merits. The subject, indeed, is admittedly of national importance, but the fear is that this country will only waken up to the full significance of that fact when the pinch of necessity has tightened to a real grip—so tight, indeed, that it will be too late to shake it off.

The purpose of this work is to point out how the methods known comprehensively as "carbonisation processes"—that is, processes involving the preliminary treatment of coal by heating it under such conditions that initial products are formed capable of being turned to economical account as sources of power—may tend to minimise this waste. To understand fully the *rationale* of the effect of heat upon coal implies some knowledge of the proximate nature of coal and of the essential differences in composition between one coal and another. On this matter knowledge is confessedly very imperfect, but at the same time a certain amount of information has been gained by the study of the action of various solvents upon coal and by an examination of the nature of the products so obtained, as well as of the changes which the coal has experienced by the treatment. Incidentally, Prof. Lewes has been led to speak of the influence of storage, *i.e.* oxidation, on the nature of coal, and its effect on its coking properties and on the products of its destructive distillation. He is naturally induced to treat of the causes of the spontaneous ignition of coal, and he points out that the phenomenon is certainly more complicated than is generally supposed, and is not wholly, or in all cases, due to the occurrence of "brasses," or any readily oxidisable form of finely divided iron sulphide, but is connected with the character of its proximate constituents.

A special chapter is devoted to the question of the classification of the various kinds of coal. Strictly speaking, the most rational method would be one dependent upon proximate composition, and perhaps in time to come we may arrive at such a system. At present our knowledge on this matter is far too partial and imperfect to warrant even the attempt, and accordingly we have to content ourselves with the admittedly empirical and irrational systems which the metallurgists have devised for us. Of course, in practice, the systems we owe to Fleck, Gruner, Seyler and others—mainly German and Austrian writers—have a certain measure of convenience, and are probably remotely based upon intrinsic differences of chemical nature, but the correlation has not been definitely traced, and is certainly not capable of being stated with precision.

The greater part of the rest of the work is concerned with the effect of heat upon coal, or, to speak more precisely, on its behaviour during the process of destructive distillation. Of course, this is a very wide subject, and has been treated at great length in many standard treatises. It has, however, not been Prof. Lewes's object to traverse well-trodden ground. His purpose has been rather to direct attention to novel points, or to offer his testimony on disputed matters. This feature of the work will commend it to the attention of those who are concerned practically with the carbonisation of coal, whether in gas manufacture, coke-oven work or tar distillation. They may not always agree with Prof. Lewes, but it will be admitted that he speaks as a well-trained chemist with the experience of a generation on practically every aspect of the subject, and that his opinions are fairly and temperately stated, such as becomes a man of science whose sole object is to elucidate the facts.

A commendable feature of the book is the excellence of the illustrations. Many of them are novel and all are of the character that experts will appreciate. T. E. Thorpe.

THE TRAINING OF GOLDSMITHS.

Metalwork and Enamelling: a Practical Treatise on Gold- and Silver-smiths' Work and their Allied Crafts. By Herbert Maryon. Pp. xiii + 327 + plates. (London: Chapman and Hall, Ltd., 1912.) Price 7*s*. 6*d*. net.

THE abolition of the apprenticeship system of training and the establishment of technical institutions for the education of young goldsmiths and silversmiths have created a demand for text-books which have in view the wants both of technical students and of those who are already practically engaged in these crafts.

The modern practice whereby the worker in the precious metals confines himself to a single branch of the craft results in technical skilfulness and in cheapness of production, but its influence is definitely against the production of craftsmen who are masters of their art. There will, however, always be a demand, and we hope an increasing demand, for work executed throughout by one man—a man who can both design and carry the work through—and text-books which will assist in the production of such men are rendering great service to the ancient craft of precious metal working. The information must be given in a form not too academic, and expressed in language that the worker of ordinary intelligence can understand.

This book is an important addition to this class of technical literature, and will be of value not only to the student but to those already engaged in gold- and silver-smiths' work. It deals with metalwork and enamelling from the essentially practical and technical rather than from the artistic or historical point of view. The author has departed from the course adopted by most writers on the subject, which consists in describing in detail the making of single articles, such as a brooch, cup, or casket.

The operations of soldering, raising, stone-setting, enamelling, &c., are fully discussed in a clear and concise manner, and the descriptions are accompanied by good illustrations.

Two chapters are devoted to a description of the materials and tools used, and to the making of small tools required for special work. The sharpening, hardening, and tempering of tools, which are matters of considerable importance to the craftsman, have also been dealt with. Designing, which is the essential basis of the gold- and silver-smiths' art, is ably discussed, and the method of teaching design adopted by Mr. Catterson Smith, at the Birmingham Municipal School of Art, for training lads who propose to enter the jewellery and metal trades is described and well illustrated.

Twenty-three plates illustrative of some of the finest examples of Greek, Etruscan, Renaissance, Celtic, and modern gold- and silver-smiths' work are given. These are taken from masterpieces exhibited in the British Museum and the Victoria and Albert Museum, and the publishers are to be highly congratulated on the excellent way in which these have been reproduced. The plates, which are fully described, will be of considerable assistance to students in studying the numerous styles of ornamentation, &c. A short chapter on the life and work of Benvenuto Cellini is appended.

A bibliography is given, but several important modern works have been omitted.

Ernest A. Smith.

GAS, OIL AND PETROL ENGINES.

The Gas, Petrol and Oil Engine. Vol. ii.: The Gas, Petrol and Oil Engine in Practice. By Dr. Dugald Clerk, F.R.S., and G. A. Burls. New and revised edition. Pp. viii + 838. (London: Longmans, Green and Co., 1913.) Price 25*s*. net.

THE first volume of this book, which we reviewed some three years ago (November 11, 1909), was devoted chiefly to thermodynamics. Dr. Dugald Clerk, with the help of Mr. Burls, has now issued the companion volume treating of the gas, petrol and oil engine in practice. The current volume is much bulkier than its predecessor, and is one calling more for the skill of an editor in its composition than for that of an author. "Practice" with gas, oil and petrol engines now covers such a ramification of diverse uses that it is exceedingly difficult to write any treatise on the subject which shall show at the same time breadth of knowledge and unity of conception; and it is characteristic of Dr. Clerk's writings that the former is always the more pronounced.

In the present volume we have one-third of the chapters attributed to each of the two authors, and the remainder a joint production, whilst the whole "correctly represents the opinions of both writers." The subjects dealt with in the various chapters include the development of the Otto and Clerk cycles, ignition arrangements, speed regulation, governing, gaseous fuels, petroleum and its products, petrol engines, carburettors, heavy oil engines, marine engines, and the future of internal combustion motors. There is also a somewhat forbidding appendix on the acceleration of reciprocating parts.

Since its first publication in 1886 the book has had for numerous reasons to be increased greatly. It is only in comparatively recent years that the petrol engine has become prominent; now, of course, it is without exception the most widespread of all prime movers. In this volume Mr. Burls deals chiefly with the petrol engine, and he has certainly made it an interesting part of the book; he discusses ably and fully those problems on which he is well known to hold decided views, although his processes of argument are occasionally obscure, especially when mathematical treatment becomes necessary. The graphical construction at the early part of chapter iv. for finding the tangential effort at the crank-pin is unnecessarily complicated, and is not likely to be much used.

A very interesting statement occurs on p. 433, where Dr. Clerk describes his method of overcoming the pre-ignition difficulty when working with coke-oven gas or with other gases rich in hydrogen. His plan is to replace some of the air in the gaseous charge by cooled exhaust products; the effect is thus described: "The inert gas addition reduces inflammability by diminishing the oxygen and by the diluting effect of the carbonic acid and nitrogen, without reducing the total mass of the charge." This is a most ingenious plan, and it would be interesting to learn how much of its beneficial effect is due to the lowering of the compression temperature on account of the greater specific heat of the carbonic acid, particularly at the higher temperatures.

The most useful recent work on the theory of the internal combustion engine has been done by the Gaseous Explosions Committee of the British Association, of which until quite lately Dr. Clerk was joint secretary. One of their discoveries was the enormous proportion of the heat loss during the expansion stroke which occurred at the crest of the temperature wave. This was shown to be a radiation loss and not a surface-cooling loss. Nevertheless, we see on p. 517 that the rating of petrol engines is discussed on the basis of the heat loss being proportional to exposed surface irrespective of temperature limits, and it would have been better to have added to this assumption some qualification.

These are, however, minor points, and for the book as a whole we have only praise. We have no doubt it will be welcomed by British engineers, who are accustomed to look on Dr. Clerk as the chief authority on all that pertains to the gas engine. His concluding remarks cannot fail to hold not only engineers, but all who are interested in the future of the internal combustion motor. Dr. Clerk considers that although the problem of improving efficiency is a fascinating one from the scientific point of view, it is not at present of vital importance, since present thermal efficiencies are sufficiently good, and it is, he considers, much more important to improve internal combustion engines in other respects. He foresees much difficulty in the way of making a gas turbine, and suggests that progress is most likely to lie in the development of the Humphrey idea, in which water propelled by gaseous explosions is made to do work in turbines. He thinks also that more attention should be concentrated on the bituminous fuel producer as a means of gas production, since for this country coal is and must long remain the chief source of power.

COMPARATIVE BIOLOGY.

(1) *Vorlesungen über vergleichende Tier- und Pflanzenkunde.* By Prof. Adolf Wagner. Pp. viii + 518. (Leipzig: Wilhelm Engelmann, 1912.) Price 11 marks.

(2) *Vergleichende Physiologie wirbelloser Tiere.* By Prof. H. Jordan. Erster Band: Die Ernährung. Pp. xxii + 738. (Jena: Gustav Fischer, 1913.) Price 24 marks.

(1) THIS excellent book is a sequel to Claude Bernard's famous "Leçons sur les phénomènes de la vie communs aux animaux et aux végétaux" (1878), and we are aware that this is saying a great deal. It has not the luminosity and fascination of the French classic, but it is a substantial and original piece of work, to which we would give the heartiest welcome. Many books have compared the plant cell and the animal cell, the plant metabolism and the animal metabolism, and so on, but Prof. Wagner's aim is different. It is to show how the plant-organism and the animal-organism tackle the everyday problems of life. Organisations built on different lines find different, but in their way equally successful, solutions of the same problems, and the comparative study has been too much neglected. We have in this book an admirable guide.

The lectures begin with nutrition—the taking in of food, the treatment of this food within the body, its distribution, storage, and transformation, and so on. The respiratory function in plants and animals is then dealt with. Then follow very interesting lectures on movement and irritability, and the author is particularly successful in his treatment of the various senses in plants and animals. The general facts and laws of response to various kinds of stimulus are admirably discussed, and the lectures end with an inquiry into the regulation and unification of functions. The reproductive function has been left for separate treatment.

Prof. Wagner has given us a very thoughtful book, which makes one reflective, and to our mind there is convincingness in its cumulative argument that biology is autonomous, and that it cannot do its own business with the instruments of chemistry and physics alone. Thus we are led at the end of these lectures to a deliberate, but by no means dogmatic, "Psycho-biology."

(2) Prof. Jordan has tackled an enormous piece of work—a comparative physiology of the invertebrates—and he is to be congratulated on the completion of the first volume, which deals with nutrition. With colossal learning, which must have meant many years of work, he discusses the nutritive function in the various classes. Incidentally, he has a good deal to say in regard to habits. The material is very well arranged; the style is clear; there are numerous good figures; and there is an index of about seventy pages. Prof. Jordan has himself made numerous contributions to comparative physiology, and he is at once critical and fair in the way he deals with the huge mass of facts which the active prosecution of a relatively young inquiry has placed at his disposal. After tracing the nutritive functions from class to class, he takes in the concluding chapter an interesting general survey of the different kinds of diet, the different ferments, the processes of secretion, digestion, and absorption, the *rôle* of phagocytes, and the process of storage. Zoologists and physiologists will be grateful to Prof. Jordan for this valuable book of reference.

OUR BOOKSHELF.

Notes on Sampling and Testing. Second edition: revised and enlarged. Pp. 96+plates. (Manchester: Marsden and Co., Ltd., 1913.) Price 1*s.* 6*d.*

THE testing-house of the Manchester Chamber of Commerce was established some eighteen years ago for the examination of yarn and cloth as regards proportion of moisture, "strength," and other physical properties. To these objects have since been added others, including the analysis of sizing materials used on textile fabrics; the testing of wood pulp, oils, metals, fuels, and water; and also investigations respecting the causes of defects in fabrics—for example, mildew, stains, and "tenderness" or deficiency in strength. The handbook contains notes explaining certain of the processes used, the standards adopted, and the reasons for the choice of methods and standards. Examples of calculations are given, and tables of numerical data, with various diagrams and curves, one showing, for instance, the effect of atmospheric moisture on the strength of different kinds of cloth. Notes on the precautions to be taken in sampling articles for testing are included.

The services of the testing-house are not restricted to the members of the Chamber of Commerce, but are available to the public generally: and during the last ten years the number of samples submitted annually has more than doubled. One notable function of the establishment is to afford help in settling differences between manufacturers or merchants, especially where the experience of the testing-house is of value and analyses are required.

For those interested in textile industries, to whom it is more particularly addressed, the book will no doubt prove useful.

Physik der Gestirne. (Bücher der Naturwissenschaft. Vol. xiii.) By Prof. J. B. Messerschmitt. Pp. 195+13 plates. (Leipzig: Philipp Reclam, jun., n.d.) Price 1 mark.

FOR German readers this small volume affords an interesting and useful summary of the astrophysics of to-day. The introductory chapters deal with spectrum analysis in general, the solar spectrum and the spectroscope; the various conditions, *e.g.*, pressure, radial motion and magnetic fields, which modify the radiation are briefly but sufficiently discussed.

A considerable space is devoted to solar physics; and, for so small a volume, the general principles are stated very clearly and completely. On debatable subjects, such as the spectroscopic proof of water-vapour in the Martian atmosphere, Prof. Messerschmitt is commendably reserved, and states the views of both sides with judicial equanimity. More space might usefully have been devoted to the subject of stellar spectra, but the main points are enumerated, and a short, special chapter is devoted to the consideration of stellar temperatures.

Various tables, such as that showing the brightness of the sun's surface at different distances from the centre, and another giving the relative brightness of the chief nebula line in various nebulæ, afford the student a clear view of many important special problems, while the excellent plates will go far in fixing the general ideas in his mind.

W. E. R.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Atmospheric Electrification during Dust-storms.

OBSERVATIONS which have been made at the Patna College since the beginning of the present year indicate that the remarkably high negative potential gradient noticed as a feature of South African dust-storms in Prof. Rudge's letter, published in NATURE of March 13, also exists while the ordinary westerly winds of the hot weather are blowing in north India. At Patna they usually blow from about 9 a.m. to 6 p.m. from the middle of March until June, and they raise a great deal of dust, though the real dust-storms seldom occur so far to the east of India. This year they are unusually late in starting, and their place has been taken on most days by east winds, during which the potential gradient is of the ordinary positive type and magnitude.

So far, measurements have only been made with a portable electrometer and water dropper, the latter mounted on a post 5·6 metres from the ground with good exposure. Until March 15 nothing abnormal was noticed. The positive gradient was rather lower than usually recorded, seldom exceeding 60 volts per metre. Negative gradients of about 30 were measured on the afternoons of January 19 and March 11, but only lasted for a few minutes. At 3 p.m. on March 15, with a hot west wind blowing in gusts, the negative gradient was about 120 volts per metre. Under similar conditions on March 16 it rose to above 400 during some of the stronger gusts. On March 23, when the wind had once more shifted to the west, the negative gradient was too high to be measured with the electrometer.

Since the copy of NATURE containing Prof. Rudge's letter reached me, April 7 has been the only day with a strong west wind. On the morning of April 6 a squall, due to a local disturbance, blew from the north from 9 to 11 a.m. It raised a certain amount of dust on the sandbanks of the Ganges, but the atmosphere was unusually clear. While the wind was blowing hard the negative gradient was about 180 volts per metre, but this gradually diminished as the wind died away, and the usual positive gradient was re-established about 11.30 a.m.

A summary of the observations made on April 7 is given below:—

Time	Gradient (volts per metre)
7.15 a.m.	24+
9.10	32−
11.30	420− rising to 500−
12 noon	much above 500−
1 p.m.	,, ,, 500−
2	about 1500−
3	,, 1650
5.30	180−
6.30	30+
8.30	above 250+
10	about 250+
10.20	130+
12	100+
12.30	36+

The rough value at 2 p.m. was obtained by a spark micrometer, the sparks being from 1·9 to 2 mm. in length. At 3 p.m. the water dropper was mounted on another post 1·6 metres from the ground, and it was just possible to measure the potential with the electrometer. After 10 p.m. the wind began to veer to the east, and it has remained in that quarter.

It is evident that a continuous record of these changes would have resembled Prof. Rudge's record of a severe dust-storm, except that the latter does not show such marked signs of a high positive gradient after sunset. Later on in the season even higher negative gradients will probably be observed, for the conditions on April 7 were scarcely typical of the hot weather, the temperature not rising above 94 and the clouds of dust not dense.

More measurements are, of course, necessary, but at present it does not appear unreasonable to suppose that from about 9 a.m. to 6 p.m. on the majority of days from March or April until June the potential gradient over a large portion of north India is reversed, and that under these conditions the negative gradient is from ten to fifty times as great as the ordinary positive change.

V. H. JACKSON.

Bankipore, April 9.

X-Rays and Crystals.

IN my former letter of March 18 (published in NATURE of April 10) I briefly pointed out that the transmitted beams of X-rays may be made visible by means of an ordinary fluorescent screen. The results of further experiments by visual method are favourable for the explanation suggested by Barkla and Bragg, in so far as the planes rich in molecules or atoms behave as reflecting planes for rays at grazing incidence.

A piece of colourless transparent fluorspar, crystallised in regular octahedron, and rock-salt in the form of a cube, were examined, with an incident beam of 1 cm. diameter. As already noticed, groups of transmitted beams are arranged on circular cones, always in contact with the incident beam, having their common vertex in the crystal, and *their axes fixed relative to it*, so that all the spots belonging to a certain cone converge into the central incident spot, as the axis corresponding to the cone approaches the incident beam. Moreover, the elongated spots are all directed towards the point of the cone diametrically opposite to the incident spot. By rotating the crystal about one of its principal axes, or about an axis bisecting the angle between two principal axes, the position of the axes of these cones was determined, leading to the result that all these axes correspond with the lines of intersection of several planes "rich in" reflecting particles, if we assume that these points are arranged in a simple space-lattice. The number of spots belonging to every cone may also be accounted for on this assumption. Even the brightness seems to conform with the "richness" of these points in the corresponding plane.

I was also able to reconstruct graphically the complete sets of spots shown in the photographs obtained by Laue, Friedrichs, and Knipping (Figs. 5 and 7) on the above assumption. Details of the investigation will appear in the near future in the Proceedings of the Tokyo Mathematico-Physical Society.

T. TERADA.

Physical Institute, Tokyo, April 6.

The Use of Alcyonarians as Money.

THERE has just been presented to the Royal Scottish Museum by Dr. E. MacKenzie, of Espiritu Santo, New Hebrides, a large Cœlenterate colony found on the shores of the island after a storm. Dr. MacKenzie supplies the information that such colonies are held in great esteem by the natives, who use them as charms, wearing constantly a few twigs contained in a small bag or basket slung to the wrist, in the assurance that so good fortune will follow. But few other than chiefs are fortunate enough to possess this valuable jetsam. The twigs are also used as a medium of barter, a fragment of a colony, say, a branch seven or eight inches long, with its associated branchlets, having the exchange value of half a dozen pigs—the staple wealth of the island—or a wife.

In view of these interesting customs a few particulars regarding the Alcyonarian colony referred to are given. The specimen in the museum is a large and much-branched Gorgonid axis, intensely black in colour, with shiny surface marked by many fine grooves and ridges, and entirely devoid of flesh or spicules. By the characters of colour, branching, and general structure of the axis it is clearly a "black coral"—the "schwarze Horncoralle"—*Gorgonia* (now *Plexaura*) *antipathes* of Esper, or some closely related species. Such forms are widely distributed in Oceania, and are known to the natives by various names, frequently signifying "sea-wood," "sea-roots," "iron-wood," and such like. The present specimen is more than 2 ft. high, but examples 5 or 6 ft. high are on record. The colonies are most frequently cast ashore after storms, but they grow in five to six fathoms off Amboina, and belong to a typically shallow-water family.

It is natural that the large and thick stems of very old colonies used by East Indian peoples for the manufacture of ornaments should be considered of great value, but it is peculiar that the small twigs of an Alcyonarian widely distributed in Polynesia, an inhabitant of shallow water, and therefore likely to be often cast ashore, should be sufficiently rare in Santo to be a highly coveted medium of exchange.

JAMES RITCHIE.

The Royal Scottish Museum, Edinburgh, April 18.

Mechanically-formed Grikes in Sandstone.

THE grikes, or channels, frequently formed by the corrosive action of carbonic and organic acids upon the surfaces of exposed limestone beds are known to most geologists, but a case I recently met with, where similar surface-features have been naturally produced upon a sandstone ledge footing a part of the cliff at Orcombe Point, near Exmouth, is, I venture to think, a phase of marine erosion sufficiently unusual to merit a detailed description.

Here the Red Marls, with intercalated sandstones, rest on Permian (?) Sandstone. This, owing to its superior hardness, forms a ledge rising abruptly from the beach to a height of about 9 ft. This ledge of sandstone, which has a fairly level surface, is backed by a mass of a somewhat softer variety in the cliff, which, at its greatest distance, is about 20 ft. from the margin of the ledge.

The surface of this ledge is grooved and channelled to a remarkable extent, and presents an appearance similar to that of limestone grikes. The longest channel has a length of between 15 and 16 feet, the deepest is 2 ft. 3 in. in depth, and the widest has a width of about 2 ft. at the top. In this widest channel is a ridge, about 1 ft. from the top, running along its centre, clearly representing an eroded parting which originally separated this widest channel into two parts. All the channels run seawards, and are deepest near the edge of the ledge. They are veritable cañons in miniature. A photograph taken from a point above the surface of the ledge is here reproduced.

These unusual features have been produced as follows:—During stormy weather the pebbles, grit, and sand on the beach are cast upon the ledge by the waves. The advancing and receding water causes the beach material to move to and fro on the top of the ledge, and thus the pebbles and sand have literally sawn out these grooves, and the work of deepening and enlarging still goes on.

The position and direction of the channels was probably originally determined by slight "fossil" ripple-marks which existed on the surface of the rock.

The sandstone forming the ledge is a fairly hard,

Grikes in sandstone at Orcombe Point, near Exmouth (looking west).

red, ferruginous rock, composed chiefly of quartz grains, the larger being smooth and rounded, or subangular, and the smaller rough and angular. The beach material is chiefly made up of quartz, quartzite, vein-quartz, sandstone, flint, jasper, and shell fragments.

CECIL CARUS-WILSON.

April 21.

Gain of Definition obtained by Moving a Telescope.

THE phenomenon described by Mr. M. E. J. Gheury in NATURE of March 27, p. 86, is familiar to me in telescopic work.

Many years ago, when I used to sweep for comets, sometimes nebulæ would be seen to enter the field which were so faint that when the telescope came to rest they were only just discernible or invisible altogether. By slowly swinging the telescope back and forth they would become readily visible, as if the process of motion had the effect of greatly multiplying their light. This was not an unusual occurrence. I remember also that it made quite a difference as to whether the object entered from the right or left side of the field. It was easier to detect a very faint nebula or comet when it entered from a certain side. I cannot now remember whether this was from the right or left (the sweeps being horizontal), but I know

I used to take advantage of the fact and sweep so that the stars should enter from the favourable direction.

E. E. BARNARD.

Yerkes Observatory, Williams Bay, Wisconsin, U.S.A., April 15.

A Brilliant Meteor on April 23.

A MAGNIFICENT meteor was seen here by me at 9h. 8m. this evening. Starting from near β Leonis, the body travelled, nearly overhead, to near η Draconis. The head was yellowish and distinctly pear-shaped, pouring out behind it a shimmering tail of reddish material. The flight occupied some 5 sec. or more, for I had time to direct the attention of the Misses Baxandall—with whom I was talking—to it, and they then saw quite half the flight. The matter left behind was quite bright, tapering off for some 3°, and then quickly fading away. There was no sound and no violent disruption. The meteor, in flight, reminded me strongly of the photographs of Borrelly's comet published by the Lick observers in 1903. A marked feature was the leisurely flight and the appearance of matter being poured out from the receding head.

WILLIAM E. ROLSTON.

"Broadwater," Fulbrooke Road, Cambridge, April 23.

Spectacles for Use with Observing Instruments.

I DO not remember ever reading or seeing any article on how people who wear spectacles should look correctly through capped lenses of scientific instruments, such as telescopes, spectroscopes, microscopes, &c., nor what sort of spectacles weak-sighted people should use for that purpose, whether their long-sighted or reading spectacles, or whether special lenses should be obtained for that purpose. If the latter, a special form of lens cap might be made for the correct spectacle glass to fit into at the proper distance from the lens cap—when it is known what is the proper distance. At present this subject seems to be ignored, and it may be worth the attention of opticians to make rules and give hints or advice on the subject, so that people with deficient eyesight, especially the aged, may have more pleasure in their observations. Perhaps some of your readers may be able to give some useful hints as to what they find it best to do in the circumstances gained by many years of practical experience.

J. W. SCHOLES.

Grimscar, Huddersfield, April 21.

THE REPORT OF THE COMMISSION ON UNIVERSITY EDUCATION IN LONDON.

WHATEVER may be the ultimate result of the report of the Royal Commission on University Education in London, there can be no doubt that the Commissioners have performed, and performed admirably, a much-needed task. For success in any great enterprise it is essential that those who are engaged in it should have a clear mental vision of what they want. It need not be precise in detail, but it must be definite in outline.

The Commissioners have produced for the first time a faithful sketch of what the University of London may and should be. It is the conception of statesmen, and not merely of educationists interested chiefly in their own subjects, their own institutions or their own degrees. It is courageous, for the Commissioners do not hesitate to express their opinions even when they know that they must be opposed to sectional views and sectional interests. It is far-sighted, for it is linked with impending reforms in secondary education, and contemplates changes which are admitted to be temporary and preparatory only to further developments, such as the establishment of a south-eastern university outside the London area. It faces for the first time the question of the cost of a great metropolitan university. Whatever other purpose it may serve, it will for long be regarded as a self-consistent and well-conceived scheme which will serve as a standard with which other proposals must be compared. Those who object may at least be expected to state their objections in a specific form; to indicate whether those objections are to some general principle or to particular details; to make it clear what alternatives they suggest, and whether those alternatives would directly or indirectly modify the whole scheme, and, if not, how they can be incorporated into it.

In discussing the report in these pages it may be assumed that the readers of NATURE are generally acquainted with the past history of the University of London, and know that the development of the internal University under the constitution established thirteen years ago has been very great, but has been hampered by disunion in the Senate. Nor was that constitution framed so as to enable the Senate to deal with the difficult problems caused by the establishment of so strong and efficient an institution as the Imperial College.

Indeed, the whole question was raised, not only as to whether a new technological university should be established in London, but whether the Imperial College should not be regarded as a super-university institution to which other universities should be expected to send their best technical students, and which should gradually eliminate all teaching of undergraduates from its curriculum. With both these proposals the Commissioners deal very faithfully. For their arguments we must refer our readers to the report itself (sections 194–198). Suffice it to say that they sum up in the statement "that the analogy of the German Hochschule fails to support the claim for a technological university in England, and that the policy of establishing a super-university is neither a possible one nor to be desired on its merits."

But while thus decisively deciding on the main questions, the Commissioners have done much, indeed, it may be said, all that is possible, to secure both to the technical colleges and to the teachers of technology in general that freedom in educational matters the securing or retention of which was the main motive of those who feared the too complete absorption of the Imperial College in the University. The safeguards provided are described below. Turning from this point, which was largely the cause of the appointment of the Commission, we come to what logically precedes it, namely, the constitution proposed by the Commissioners for the University. It is chiefly on this point that the arrangements under which it has been working since 1900 have broken down.

The work of the University was then classed under two main heads, the internal and external sections respectively. The Senate consisted of fifty-six members, of whom thirty-two were equally divided between the graduates and the teachers, or practically between the external and internal sections, the remainder being chiefly representatives of learned and professional bodies. It is the opinion of the Commission that this scheme has not been successful, and that it has led to ambitions on the part of the external side of the University which, if fulfilled, would seriously hamper the development of a true teaching university in London.

The Commissioners, after describing the claims put forward in the report of the Council for external students, state that, "in our opinion it is these claims which, far more than anything else, form the real ground of the defective working of the University in so far as that is due to the present relations of the internal and external sides."

How far the External Council has departed from its true position is shown by the fact that it desires to be called the Imperial Council, while the present Academic Council is to be designated the Metropolitan Council, a title which implies, and is no doubt intended to imply, an inferior status. A house thus divided against itself cannot stand, and, as has been generally expected, the time has come for another drastic reform.

In outlining the measures necessary for this purpose the Commissioners propose to assimilate the constitution of the University of London to those of its northern sisters. In London, as in Manchester, the supreme legislative body will be a Court, consisting in London of about 200 persons, on which ample room can be found for all interests connected with the University.

The executive powers will be exercised by a small Senate, consisting of the Chancellor, Vice-Chancellor, and Chairman of Convocation, five persons appointed by the Crown, two by the Court, two each by the Academic Council and the London County Council, and one by the Corporation of the City of London.

Large powers of delegation are given both to the Court and the Senate, and, subject to the statutes and to the financial oversight of these bodies, the educational work of the University will be in the hands of faculties, the constitution of which differs in different cases, though in all the members will be wholly or in the main teachers of the University. These bodies are to have the power to determine generally the conditions for the award of degrees and diplomas, the courses of study, and the conduct of the examinations. They will present candidates for degrees and advise the Senate on the needs of the faculties. They are expressly prohibited from issuing detailed syllabuses, "for this is a matter for the professor, in consultation with his colleagues in the same branch of learning." They are to determine the respective parts played by written, oral, and practical examination, and by records of work, in the tests for the several University examinations, and to appoint the assessors who are to take part therein.

The rights of the teachers as a body and as individuals are therefore amply secured.

These privileges can, however, only be conferred if the standing of the professors is commensurately high, and the Commissioners accept provisionally the standard already practically set in the appointment of University professors.

An Academic Council will consist primarily of the deans of the faculties and of eight members elected by the faculties in common session. This Council may be regarded as exercising a coordinating influence on the faculties, as advisory to the Senate, but as capable of exercising such powers of the Senate as may be delegated to it.

Full privileges of separate examination will be enjoyed only by constituent colleges and departments which have either been established by the University or have consented to incorporation. The teachers in institutions which do not satisfy these conditions will practically have the same position as the schools of the University now occupy. Their teachers will be banded into boards which will lay down the courses of study and supervise the tests for degrees, &c., reporting to the Senate through the faculties. The system of the separate recognition of teachers in minor institutions will be abandoned, and the common or general examination, devised for the schools which are not constituent colleges of the University, will serve for the examination of external students, or, as they are to be called, unattached students, except in the cases of medicine and technology.

This is no hardship to external students. At present they are examined by specially appointed examiners who have in general no common experience, who need not necessarily be teachers, or may have ceased to be teachers.

They will now be examined by men necessarily and actually engaged in teaching. But these men will be drawn from a number of institutions, and the papers will only contain questions which they, acting in common with assessors, or, if the term is preferred, external examiners, think are fair to all their own students, however differently the students may be taught. The possible vagaries of one or two men will therefore be neutralised by the opinions of their colleagues and assessors. At present two "hanging judges" may affect the results. In future their influence will be tempered by more merciful colleagues, and the same scheme which prevents undue severity will also check a too exuberant leniency. The absence of detailed syllabuses will tend to defeat the crammers, but the fact that the papers are to be set to the students of the examiners themselves, and that those students are taught in various institutions, will check individual excursions outside the limits of a syllabus which the majority of unprejudiced experts would regard as fair.

The arrangements for technology are of a special character. The interests of that subject will be entrusted to a committee of fifteen members, including the Vice-Chancellor, the rector of the Imperial College, and other members appointed as to a bare majority by the Senate, and as to the remainder by the governing body of the Imperial College. University and King's Colleges would each be represented by two of the appointees of the Senate, and three-fourths of the whole would consist of men of affairs and experts in the branches of technology dealt with. The income of the Imperial College and that available for the departments of engineering in University and King's Colleges would be at the disposal of this committee; and the annual budget of the committee would be submitted to the Senate, the governing body of the Imperial College, and the delegacies of King's and University Colleges.

Such, in very brief outline, and with many omissions, especially that of the important proposals with regard to medical education, is the scheme of the Commissioners, and they estimate that 99,000*l.* a year will be required to carry it into effect. They also consider that the headquarters of the University should be situate in Bloomsbury.

They have evidently done their best to meet the reasonable desires of all interests. The professors will have a freedom of teaching and testing their pupils which they have not enjoyed before. The internal students will be members of a more real and efficient teaching university. External candidates will probably have a better test than that to which they have been accustomed. These advantages must no doubt be purchased by some sacrifices in so far as they touch vested interests, but the whole scheme provides a much more satisfactory prospect both for internal and external students than that now in force.

RECENT HYDROGRAPHIC INVESTIGATIONS.[1]

In the first of the publications referred to below, Dr. Rolf Witting gives an account of the hydrographic observations—sea-temperatures, salinities, oxygen-contents, current and ice observations—made in the Gulfs of Bothnia and Finland during the year 1911 by the Finnish hydrographers. The paper consists almost entirely of tables, and these are models of clear and orderly arrangement.

The second publication contains the hydrographic data collected during the voyage to Spitsbergen, in 1910, of the Norwegian ship *Farm*. The observations are discussed by Drs. Helland-Hansen and Nansen, and deal chiefly with the distribution of the Atlantic current in the sea to the west of Spitsbergen. A considerable part of the paper is taken up with a discussion of the errors of the hydrographers who had previously investigated the same area; but in addition to this the authors describe the gradual disappearance of the Atlantic current to the north-west of Spitsbergen, as this water becomes diluted by lighter arctic water flowing round the South Cape. There is a discussion of the parallelism in the annual variations in temperature of this Atlantic Spitsbergen current, and those of the Atlantic Norwegian stream. "Temperature anomalies" are compared—that is, the deviations, in each year, from the mean of a number of years. The variations in temperature of the Atlantic Spitsbergen stream are, then, roughly parallel to those of the Norwegian stream, *if the former are compared with the latter of two years' previous date.* That is, the water flowing to the north from the Faröe-Iceland channel takes about two years to travel from the latitude of 62° N. to that of about 78° N. The variations in temperature anomaly in the sea to the west of Spitsbergen are also parallel to the variations in the area of ice-free water in the Barentz Sea in May of the same year.

The third paper is of considerable interest and importance. After indulging in a polemic with reference to the erring Swedish hydrographers, Dr. Nansen considers the mode of origin of the cold water occupying the basins of the North Atlantic and Norwegian seas. These water-masses are very homogeneous. At the bottom of the Norwegian Sea there is a salinity which varies only between 34·90 per cent. and 34·92 per cent., and thus requires very careful investigation in order to disclose differences of a real nature. The submarine Faröe-Iceland ridge divides the northern ocean into two masses with respect to the temperature of the bottom water: at a depth of about 1000–2000 mètres the water on the Atlantic side of the ridge has a temperature of about $+2°$ C. to $+3°$ C.; on the Norwegian side the temperature of the sea-water at the same depth is about $-0·5°$ C. to $-0·8°$ C.

How does this cold and dense bottom water originate? It does not come from the southerly-flowing, cold polar currents, for this water is of low salinity, and in spite of its low temperature its density is less than that of the bottom Atlantic and Norwegian water, so that it cannot sink to near the sea-bottom. It does not proceed from melting ice, for water of such origin has also a very low salinity, and, notwithstanding its low temperature, its density is also low. The southerly-flowing polar currents, indeed, protect the underlying warmer water-masses from cooling, and melting ice has the same effect. In both cases the sea is covered with low-saline water which does not mix by convection with that beneath it. In order that a vertical circulation, accompanied by the formation of a cold bottom stratum of water, may occur, certain conditions are necessary:—(1) The water at the surface of the sea must not be in rapid horizontal movement; the best conditions are those in the centre of an area possessing a cyclonic circulation.

[1] (1) "Abhandlungen der finländischen hydrographischen-biologischen Untersuchungen." No 10. Pp. 132+4 Taf. (Helsingfors, 1912.)
(2) "The Sea West of Spitzbergen. The Oceanographic Observations of the Isachsen Spitzbergen Expedition in 1910." Vidensk. Skrifter. I., Mat.-Naturv. Klasse, No. 12. Pp. 89+6 plates. (Christiania, 1912.)
(3) "Das Bodenwasser und die Abkühling des Meeres." *Internat. Revue Ges. Hydrobiologie u. Hydrographie*, Bd. v., Heft i. Pp. 42+12 figs. in text. (Leipzig, 1912.)

(2) The surface water must be of approximately the same salinity as that of the sea bottom; if it has a much lower salinity, its density may not be increased by a reduction of temperature to an extent sufficient to set up convection movements reaching to the sea-bottom. (3) It must be cooled to a slightly lower temperature than that of the water at the sea-bottom, for its adiabatic contraction, by pressure, as it sinks, must warm it slightly; this may be the cause of the slight increase in the temperature of oceanic water as we approach great depths—an increase which has been attributed to the emission of heat by radio-active substances in the oceanic bottom-deposits. (4) The *formation* of ice on the sea-surface may favour convection currents by raising the salinity of the superficial water; but this is not an important factor.

The cold bottom water of the North Atlantic Ocean originates in a restricted area of sea, outside the boundaries of the southerly-flowing polar current, and lying to the south-east of Greenland. Some of this water may also proceed from the surface of the Norwegian Sea after flowing over the Faröe-Iceland ridge.

Incidentally Dr. Nansen directs attention to the presence of Mediterranean water in the channel between Ireland and Rockall. This originates from warm and dense water flowing out as an intermediate current through the Straits of Gibraltar. The presence of this water in British seas was pointed out by Dickson in 1909 as the result of observations made in 1903 by Wolfenden. Dr. Nansen in 1909 referred to the methods of these observations as "so inaccurate as to be of little use." Nevertheless, he now adopts the conclusions drawn from them, without, however, referring to Dickson's prior discovery.

J. J.

SOUTH AFRICAN INSTITUTE FOR MEDICAL RESEARCH.

SOUTH AFRICA has decided to have an institute for medical research on the same lines as the Pasteur Institute in Paris, the Lister Institute of Preventive Medicine in London, or the Rockefeller Institute in New York. To this end a new building is now in process of erection in Johannesburg, and is expected to be complete in about twelve months.

A site has been provided by the Government, and we understand that the cost of building and equipping the new institute will be provided by the Witwatersrand Native Labour Association. The maintenance of the institution will be undertaken by the Government of South Africa and the association in equal shares.

A very satisfactory feature of the institute will be its close proximity to the largest hospital in South Africa, with which it is intended that it should work in conjunction. It will also be equipped with four wards for the purpose of treating patients, who will be the subject of special study.

From the present plans, the institute seems to be suitably arranged, and will be an imposing structure. It will comprise, in a main block, forming a two-storied quadrangle, the institute offices, experimental and observation hospital, animal house, mortuary, and director's house. Ample space is allowed here for future extension. Of this main block the northern and southern sides are prolonged eastwards and westwards to form two further quadrangles. These will contain the hospital wards and research laboratories, also library, museum, and further laboratories. The building will carry as well a lecture theatre, basement workshops and storage rooms, and a number of rooms for miscellaneous scientific purposes. A dome eighty feet in height will crown the building, and will carry a finial emblematic of the surrender by Death of his secret, and we understand that a second dome of equal magnitude is aspired to. Although we realise that an institute which is intended to render valuable service to the State should be housed in fashion suitable to the importance of the work it is to undertake, we sincerely hope that contemplation of the domes and the finial will not distract the attention of the authorities from the fact that the success of their scheme will essentially depend upon the *personnel* of the staff and the funds made available for scientific investigation.

The research work of the institute is, we understand, to be primarily directed towards the industrial diseases of the Transvaal, but all diseases will come under its scope. It is intended that research fellowships shall be available for medical men, in order that they may carry out special lines of investigation; also it is hoped that in the near future medical students will be enabled to undertake courses in pathology and bacteriology at the institute, of a character which can now only be attended in Europe.

Two appointments to the staff of the institute have already been made: the director of the institute will be Dr. Watkins Pitchford, and the statistician Dr. G. D. Maynard, both of whom have already accomplished sound work in connection with one or other of the public health organisations of the colonies now forming the Dominion of South Africa.

EDUCATION OF THE AUDITORY CENTRES.[1]

PROF. MARAGE, who is well known as an otologist and for his researches in physiological acoustics, has issued a small but suggestive pamphlet on what he terms the education of the auditory centres. It is known that there are cases in the clinique of the aurist where there is sensitiveness to even feeble noises while there is deafness to music and to speech. In others the patient may hear noises, music, and even speech sounds, but without any understanding of the meaning of the speech sounds. Prof. Marage

[1] "Education et Rééducation des Centres auditifs." By Prof. Marage. Pp. 15. (Paris, 19 Rue Cambon.)

explains these facts on the supposition that the cause is not to be sought in the mechanism of the ear alone, but in the relation of this mechanism to different parts of the brain.

The paths by which nervous impulses, generated by a sonorous vibration, say, in the cochlea, are communicated to the brain, are very complicated, and come into anatomical connection with many nervous centres. Such centres may be considered as being of higher and lower orders, and the nervous impulses may pass from lower to higher, calling forth at each stage a particular sensation—say, that of a noise or of musical sensations—until they reach the highest cerebral centres where there is the appreciation of all kinds of auditory sensations, such as noises, music, and speech.

Prof. Marage's method of stimulating the ear by his ingenious syren is well known. This instrument can transmit to the drumhead sonorous waves of a measured intensity (that is, the air-pressure is measured), and the special quality of each vowel tone is produced by sending the waves of pressure through resonators moulded on the form of the mouth and throat cavities for each vowel. Thus, by using the syren methodically, the ear may be stimulated by tones that, as regards both intensity and quality, are natural to it, instead of tones produced by tuning-forks, or noises, or by spoken words. Thus the ear and the nerve centres may be put through a course of education, a kind of drill, in short, produced by the syren. The results are said to be very encouraging with cases of whole or partial deaf-mutism.

Prof. Marage also gives in this pamphlet copies of tracings of vowel-forms produced by this syren which are well worthy of study, but he does not mention how these beautiful photographs were obtained. The gist of the whole matter is that in attempting to explain auditory mechanisms, we must not confine our attention to the ear alone, but to the ear as associated with auditory nerve centres. The investigation, in short, becomes more and more complicated.

JOHN G. MCKENDRICK.

NATURAL HISTORY IN CEYLON.

SPOLIA ZEYLANICA is an excellent quarterly publication designed to promote a knowledge of the natural history of Ceylon and its surrounding seas. It was established by Prof. A. Willey (now at Montreal) some eight or nine years ago when he was director of the Colombo Museum, and has been kept up since with admirable skill and energy by his successor, Dr. Joseph Pearson, the present editor. The part for January, 1913, contains, along with several notes on land and fresh-water animals, three articles of special interest on pearl-oyster fisheries.

The first article, by Captain Legge, "Master Attendant" at Colombo and inspector of the pearl banks, is semi-popular, and is written rather from the navigator's and the historian's point of view, containing notes and stories of fisheries and celebrated pearls. Here and there in Captain Legge's chatty account of his personal adventures on the pearl banks one comes on quite important observations, such as, when describing a walk in diving-dress over the sea-bottom:

> Immediately I walked off the "paar" I was upon very loose sand, in waves like giant furrows in a ploughed field; whilst for quite two feet high above the ground there was sand in suspension. Here oysters are covered up, buried and destroyed immediately.

Yet some recent writers have argued that there can be no movement of the sand on the bottom, and that beds of oysters cannot be silted up by moving sand.

Captain Legge gives us an additional instance of the now well-known danger to beds of oysters from predatory elasmobranch fish, as follows:

> At the inspection in November, 1902, I decided that a certain bed was quite the gem of those to be fished in March, 1903; the oysters were larger and older than any others I had inspected, and were very plentiful; however, as I was passing over this spot on my way back at the end of the inspection, I observed a very large shoal of rays in the vicinity. In the following March, about the second week of the fishery, I moved to this my pet bed of oysters, only, however, to be told by the divers that there were no living oysters there. I at once descended in the diving dress and found the bottom of the sea strewn with empty oyster shells, each valve turned nacre upwards and shining, giving a very curious effect, whilst each shell or valve was broken obviously by external pressure into three pieces. This could only have been done by the powerful jaws and teeth of the ray.

The second article is a well-considered, judicial account of the scientific work on the Ceylon pearl banks in the last decade, 1902 to 1912, by the editor, Dr. Pearson, director of the Colombo Museum and Government Marine Biologist. Dr. Pearson passes in review the scientific exploration of the pearl banks in 1902, the recommendations in Prof. Herdman's report to the Government, the formation of a financial syndicate in 1906 to take over a twenty years' lease of the fisheries at a large annual rental, their two highly profitable fisheries which cleared the ground of adult oysters, and then the subsequent failure of yield and resulting barren condition of the banks. The various operations suggested and performed are discussed, and the conclusion is reached that:

> The work subsequent to Herdman's reports gives very little evidence that his recommendations have been carried out seriously.

Dr. Pearson brings together a good deal of argument in favour of the possibility of oyster-beds being buried and lost by movements of the sand, and he quotes some personal observations, made on the bottom by the inspector of pearl banks, such as:

> What impressed me most was that the spots I dived on last March, which were then level rock, with a coating of 3 or 4 in. of sand, had now as much as a foot of sand in places. All over the sand was in fairly deep ridges, not so deep as the ridges of the

paar proper, but quite distinct from the appearance of the sea bottom last March.

The third "pearl-oyster" article, also by Dr. Pearson, is a report on the remarkable "window-pane oyster," *Placuna placenta*, in the great inland sea at Tamblegam, near Trincomalee; and other papers, by various authors, on fresh-water fishes, Oligochætes, Termites, &c., all show that the investigation of the natural history of Ceylon is in capable hands, and bids fair soon to make the fauna and flora of that charming island better known than those of most other parts of the eastern tropics.

NOTES.

As we went to press last week a case was concluded in the course of which the methods of anti-vivisectionists were again exposed. A Swedish lady, Miss Lind-af-Hageby, brought an action against *The Pall Mall Gazette* and Dr. Saleeby for alleged libel published in *The Pall Mall Gazette*. The jury, after listening to sixteen days of talking, gave their verdict for the defendants, and the judge received their verdict with most emphatic and outspoken approval. It has all happened before. There comes an opportunity for legal action: the statements of anti-vivisectionists are brought to the test of evidence on oath; the whole thing is thrashed out in the Law Courts, and the inevitable verdict is given. *The Pall Mall Gazette* has done a great service to the nation by thus exposing, once more, the uncharitableness—to say the least —of anti-vivisectionists. The Research Defence Society, likewise, deserves the thanks of lovers of truth. We trust that the public will bear in mind the lesson of this case, and will treat with contempt the methods upon which the obscurantism of anti-vivisection thrives. A campaign which appeals to those who have been least fortunate in the matter of education, inflames passion, stirs up hatred, and delights in imputing evil to men who are devoting their lives to the increase of knowledge of diseases which afflict mankind, may not be stopped on its downward course by the verdict given last week, but the light which was thrown upon it in the course of the evidence will perhaps do something to scatter the thick darkness of prejudice which anti-vivisection requires for its existence.

THE Bill to consolidate and amend the law relating to ancient monuments was read a second time last Thursday in the House of Lords. Such a measure must necessarily be tentative, and Earl Beauchamp admitted that it was not ideal. But he claimed justly that it was a considerable step for the object in view, while in no way penalising owners or interfering with the rights of property. The same difficulties occur as in other branches of the movement to make the country a decentralised museum, both of antiquities and of natural history and scenery. But there are also special difficulties in the case of ancient monuments. The Marquess of Salisbury pointed out that consideration would have to be given to the resident owner of a historic house. The question might arise as to whether he could be precluded from throwing two bedrooms into one. The case of cathedrals is peculiar, as Earl Curzon of Kedleston showed; they are not protected by a faculty, as churches are, but are the absolute property for the time being of the dean and chapter. Earl Beauchamp had not seen his way to include ecclesiastical buildings, but it appears that the bishops would not object to the inclusion of cathedrals. The power of purchase by the State is eliminated from the Bill; full powers for a Preservation Order are considered to render this unnecessary. The power of purchase is given to the local authorities, chiefly in view of the smaller monuments of local interest. Here comes in the difficulty of funds; even for small purchases there must be an increase of the rates. Meanwhile the larger monuments seem to be unprotected. There is no doubt that owners of great historic heirlooms do treat them as in trust for the nation. But the modern tendency is to bring this spirit into the machinery of organisation. The passing of such a Bill may be expected to react favourably on the connected questions of nature reserves and the endowment of science.

THE relation between insect-eating birds and the abundance or otherwise of insects, ticks, and other creatures which may act as hosts for organisms associated with various diseases, is known to every biologist. A correspondence between Sir Harry Johnston and the chairman and secretary of the Plumage Committee and Textile Trade Section of the London Chamber of Commerce, published in *The Times* of Tuesday, April 29, deals with some points of this relationship, with particular reference to tsetse-flies, mosquitoes, and other blood-sucking insects of Africa. Sir Harry Johnston points out that tsetse-flies of the genus Glossina are particularly abundant in all those parts of West and Central Africa where the plumage trade has done so much to lessen the numbers of the insect-eating birds—more especially white herons (egrets, large and small), ibises, rollers, bee-eaters, glossy starlings, drongo and "cuckoo" shrikes, bishopfinches, and kingfishers. As remedial measures to prevent the disturbance of the balance of nature caused by the destruction of these birds, he suggests "that the secretary to the British Museum (Natural History) or the secretary to the Zoological Society, or perhaps the two jointly, should be asked to compile a list of species, genera, and perhaps families of birds which should be placed on the prohibited list. That is to say, that the skins or other trophies of such birds should be forbidden as an article of import into Great Britain and Ireland and into all parts of the Empire of which the fiscal affairs are influenced by the Foreign and Colonial Offices; and that we should use our best endeavours with the Governments of the self-governing portions of the British Empire to secure a like prohibition in their own Customs regulations."

IN a letter to the Lord Mayor, the Prime Minister has announced the extent of the provision which the Government proposes to make for the dependents of Captain Scott and of those who so heroically lost their lives with him in the Antarctic. The Government intends to ask Parliament to sanction a Special

Vote sufficient to provide as follows:—For Lady Scott (in addition to the Admiralty pension of 200*l*. per annum for herself and 25*l*. per annum for her son, until he reaches the age of eighteen) an annuity of 100*l*. For Mrs. Scott, the mother, and Mrs. Campbell and Miss Grace Scott, the sisters, of Captain Scott, a joint annuity of 300*l*. For Mrs. Wilson, the widow, and Miss Mary Souper, the sister-in-law, of Dr. E. A. Wilson, a joint annuity of 300*l*. For Mrs. Evans, the widow of Petty Officer E. Evans (in addition to the pension and allowances awarded to her by the Admiralty, amounting to 13*s*. 6*d*. a week), a further annuity of 12*s*. 6*d*. a week for herself and 3*s*. a week in respect of each of her children up to the age of eighteen. The Government of India, in the service of which Lieutenant Bowers was before joining the expedition, has offered to provide pensions, amounting in all to 100l. per annum, for his mother and sisters. Captain Oates, the fifth member of Captain Scott's southern party, was unmarried; and as no mention is made of any relatives, it may be assumed that he was possessed of ample means. In addition to the provision referred to above, the total amount subscribed by the public as a memorial for the dead explorers and kindred purposes is 55,760*l*.

On Monday last Sir Clements Markham, at the meeting of the Royal Geographical Society, gave a paper on Vasco Nuñez de Balboa, in commemoration of the fourth centenary of the discovery of the Pacific Ocean in 1513. The anniversary actually falls in September. The author did full justice to the discoverer's strength and many other excellences of character, which stand out in contrast with the majority of his compeers in the same field; the question, often asked, was repeated, What would the history of western South America and its highly civilised native races have been if Nuñez and others such as he had been allowed the chance to establish friendly relations with them and assimilate their ideals with those of Europe, instead of their suffering the extreme penalty of extermination? Two noteworthy efforts of geographical theorising were discussed as following upon Nuñez's discovery. The first was the well-known and successful endeavour of Magellan to turn the flank of the South American barrier, and to sail his vessel directly from the Atlantic into the Pacific. The second, less familiar, was the brilliant reasoning by which Andres de Urdaneta, in 1565, succeeded in piloting a return voyage across the Pacific from west to east, for the first time, by following a northerly course, on which were found favourable winds, the reverse of those which prevailed on the more southerly course followed by the earlier navigators across the ocean from east to west. Reference was made to the work still awaiting trained explorers in the very area of Nuñez's crossing of the isthmus of Darien.

We are glad to learn from the annual statement on the work of the Post Office, made in the House of Commons on April 24 by the Postmaster-General, that it is proposed to establish a new service for the synchronising of clocks. For a small fee per annum the Post Office will send every day an hourly time signal. Any institution, business house, or industrial establishment to which it is important to have the correct time and which is willing to provide the internal apparatus for the clocks can obtain for a small fee an hourly time service. The fee may vary with the distance, but if there are a sufficient number of subscribers it will be about £2 a year. The Greenwich time signal will be transmitted once daily over telegraph circuits for the regulation of master clocks fixed at suitable "distributing centres" at head or branch post offices, and these master clocks will transmit hourly impulses to the premises of persons requiring the service. The Post Office will provide and maintain the distributing wire up to a suitable point at the renter's premises, but it will rest with the renter at his own expense to fix and maintain to the satisfaction of the Post Office all other wiring within his premises, as well as the clock and the synchronising mechanism. The arrangement will be confined for the present to the central districts of large towns. It will be recalled that the British Science Guild has taken a leading part in directing attention to the importance of synchronising all clocks publicly exhibited. In the fifth annual report of the guild a committee appointed to deal with the subject described the position of the subject at home and in some other countries, and stated the results of representations made to the Post Office, the London County Council, the Corporation of London, and other authorities. The hope was expressed by the committee that the Post Office would before long be in a position to offer facilities to the public for the synchronisation of clocks at such rental rates as should remove the main objections which have been urged to the general adoption of the principle. The announcement now made by Mr. Samuel seems to represent the realisation of this desire.

The first conversazione of the Royal Society for this year will be held in the rooms of the society at Burlington House on Wednesday, May 7.

The death is announced, on April 25, of Prof. J. Park, professor of logic and metaphysics in the Queen's University (formerly Queen's College), Belfast, since 1868.

The Berlin correspondent of *The Times* announces that Prof. Fritz von Bramann, professor of Halle University, and director of the surgical laboratory there, died on April 26, at fifty-eight years of age.

We learn from the *Revue Scientifique* that the teachers of the Normal School at Avignon, of which M. J. H. Fabre, the entomologist, was a pupil, are taking steps to raise a fund with the view of erecting a monument to "The Insects' Homer." The general council of Vaucluse has voted 1500 francs to the fund.

On Saturday, May 10, Mr. H. A. Humphrey will begin a course of two lectures at the Royal Institution on Humphrey internal-combustion pumps. The Friday evening discourse on May 9 will be delivered by Mr. F. Balfour Browne on the life-history of a water-beetle, and on May 16 by Captain Cecil G. Rawling on the Pygmies of New Guinea.

The Geologists' Association has arranged a Whitsuntide excursion to Nottingham, from May 9 to May

14. The directors are Prof. J. W. Carr, Prof. H. H. Swinnerton, Mr. G. W. Lamplugh, and Rev. E. H. Mullins. The party will travel *viâ* Great Central Railway on Friday, May 9, by the train leaving Marylebone Station at 4.45 p.m., and due at Victoria Station, Nottingham, at 7.37 p.m.

DR. ALEXANDER SMITH, professor of chemistry at Columbia University, New York, has accepted election to the chair of that subject at Princeton. Prof. Smith is a Scotsman by birth, and graduated in science at Edinburgh University, where he was for a short time an assistant in chemistry. He went to America in 1890, and held professorships successively at Wabash College and the University of Chicago before his appointment to Columbia.

IN our issue of December 19, 1912, Prof. Milne announced that Mr. Shinobu Hirota had been compelled by ill health to return to his native country, Japan. We regret now to learn that Mr. Hirota died on April 24. During the eighteen years he lived in England as assistant to Prof. Milne, he played an active part in establishing a new branch of geophysics, and had he recovered he might well have continued in Japan the work to which he was devoted.

AT an extraordinary general meeting of the University of Durham Philosophical Society, to be held in the Physical Lecture Theatre, Armstrong College, Newcastle-on-Tyne, to-morrow, May 2, Sir J. Alfred Ewing, K.C.B., F.R.S., will deliver a lecture on the structure of metals. The occasion is the first meeting to be presided over by the Duke of Northumberland, and has been arranged in connection with his installation as Chancellor on the following day.

THE council of the Institution of Civil Engineers has made the following awards for papers read and discussed during the session 1912–13:—A Telford gold medal to Mr. Murdoch Macdonald, C.M.G. (Cairo); a George Stephenson gold medal to Mr. G. D. Snyder (New York); a Watt gold medal to Mr. H. A. Humphrey (London); Telford premiums to Messrs. C. W. Methven (Durban), B. Hall Blyth, jun. (Edinburgh), C. J. Crofts (Durban), Frank Grove (Canton), B. T. B. Boothby (Hankow), and Francis Carnegie (Enfield Lock), and the Manby premium to Capt. C. E. P. Sankey, R.E. (London).

THE French aviator, M. Gilbert, on April 25 covered a distance of some 512 miles, from near Paris to Vittoria, in northern Spain, on a biplane, in 8 hours 23 minutes, without once alighting. He is reported to have travelled from Paris to Bordeaux at a speed averaging seventy-four miles an hour. Between Bordeaux and Biarritz he flew at a height of nearly 10,000 ft. Starting again after two hours' rest, he added another 155 miles to his flight, arriving at Medina del Campo, thus covering, in less than eleven hours, 668 miles.

A DISTINGUISHED committee has been formed, with the King of Italy as president, to obtain funds by public subscription for the institution of suitable memorials of the late Prof. Giovanni Schiaparelli, whose work for astronomical science is of the first rank of importance. It is proposed to erect to his memory a monument at Savigliano, his birthplace, and to place a tablet bearing his effigy in the Brera Palace at Milan, where he described his observations and conclusions. Among the members of the honorary committee are the presidents of the chief scientific societies in Italy, rectors of the universities, and directors of astronomical observatories. The president of the executive committee is M. Gullino, the Syndic of Savigliano (Cuneo), to whom subscriptions should be sent.

THE executive committee of the British Science Guild has issued a report on the Milk and Dairies Bill and on further legislation desirable on the subject. While expressing general approval with the Bill as a whole, the committee fears that its largely permissive character will allow local authorities to ignore the powers conferred upon them. It considers that the medical officer of health is placed in a difficult position by having to criticise, and possibly to be instrumental in instituting legal proceedings against, those who appoint him, who may have the power to terminate his appointment. The committee also regards the provisions as inadequate to check the supply of tuberculous milk. Comment is made on bovine tuberculosis and the means for stamping it out, and the opinion is expressed that the Bill grapples with the evil of bovine tuberculosis only in its fully developed form, and not with the less manifest or latent forms of the disease, which it is equally, or even more, important should be dealt with.

WE are informed that the Crocker Land expedition, which was postponed for a year on account of the death of Mr. George Borup, has been completely reorganised during the past year, and that the plan now is to send it northward in July next. The object of the expedition is the scientific exploration of the land supposed to lie north-west of the line of islands stretching from Grant Land to Prince Patrick Land. In addition to the mapping of the new land and of the uncharted coast lines in the vicinity of Grant Land and Axel Heiberg Land, the party will carry on studies during a period of more than two years in many other branches of science, including meteorology, terrestrial magnetism, wireless telegraphy, seismology, geology, zoology (both vertebrate and invertebrate), botany, ethnology, and archæology. The *personnel* of the expedition is as follows:—Mr. Donald B. Macmillan, leader of the expedition; Ensign Fitzhugh Green, U.S. Navy, map work, electrical work, terrestrial magnetism, and seismology; Mr. W. Elmer Ekblaw, geologist and ornithologist; Mr. M. C. Tanquary, zoologist, with particular reference to invertebrate zoology.

IN addition to the appropriation for defraying the expenses of the current work and operations of the department of terrestrial magnetism, the trustees of the Carnegie Institution of Washington, at its annual meeting last December, set aside one hundred thousand dollars for the purchase of a site and erection of a building for the department. After an inspection of various sites, one embracing about seven acres, situated in the district of Columbia, near Rock

Creek Park, was finally found suited for the purpose, and has now been purchased. The building will be about 52 by 101 ft., and will consist of two stories and a basement. It will contain adequate facilities for office, laboratory work, and instrument shop, and will be ready for occupation early in 1914. The magnetic survey yacht *Carnegie* left St. Helena on April 9 bound for Bahia, and is expected to return to her home port at the end of the year, thus completing the three years' circumnavigation cruise begun in June, 1910. After leaving Bahia she will once more call at St. Helena, and proceed next to Falmouth, where she is due early in September. It will be recalled that the *Carnegie* made Falmouth one of her chief ports on the cruise of 1909.

One of the most beautiful objects in western England is the famous screen in Banwell Church, about seventeen miles south-west of Bristol, in co. Somerset. Among the most treasured possessions of the parish is a record of churchwardens' accounts between 1515 and 1602, which give full particulars of the cost of the screen and of the workmen engaged upon it. These have been abstracted, with good illustrations of this fine piece of woodwork, by the vicar, Rev. C. S. Taylor, in part i., vol. xxxv., of the Transactions of the Bristol and Gloucestershire Archæological Society for 1912.

Nigeria presents a promising and almost unworked field for the collection of folk-tales. Major A. J. N. Tremearne, in his recently published "Hausa Superstitions and Customs," has issued a large number of tales. From Southern Nigeria Mr. E. Dayrell, District Commissioner, in continuation of his "Folk Stories from Southern Nigeria," published in 1910, has now published, through the Royal Anthropological Institute, a series of Ikom folk-stories. These are of much ethnological interest, as they throw much light on matrimonial customs, of which female circumcision forms part. He also deals with human sacrifice and the Ju-ju form of sorcery, on which our information is still incomplete. "The more," he says, "one learns about Ju-ju the more hopeless it seems. It must seem incredible to people at home that a man can die because a Ju-ju has been made against him—for example, two sticks crossed on the path with, say, a rotten egg and a fowl stuck on a stick, the man's name having been 'called.' And yet one knows of numerous instances where men have died, and young, healthy men, too, against whom such a Ju-ju has been made." Parallel instances from Australia at once suggest themselves. Mr. Dayrell thinks it possible, in such cases, that poison may have been administered, but it is most difficult to get any proof.

The power of the body to adapt itself to its needs is one of the most familiar of physiological truths. It has long been known that among the organs the heart shows ready adaptability. This is very strikingly illustrated by numerous measurements recently published by Dr. Grober, of Jena (*Naturwissenschaftliche Wochenschrift*, April 6 and 13). The figures refer to men in different employments, and to various animals with varying activities. The most remarkable fact (the explanation of which is not clear) recorded is that the right side of the heart usually increases in bulk more than the left side does.

The British Review for April contains an interesting article, entitled "Colour-hearing," in the form of a dialogue between the writer ("C. C. Martindale"), an "exceedingly eminent specialist" ("the Doctor"), a lady ("Mrs. X."), a scoffer ("the Metaphysician"), and "N. K.," who is able to "hear colour" (or, more accurately, to "see sounds"). No one acquainted with the characteristics of synæsthesia can doubt that it is a substantially accurate account of a conversation that took place. Indeed, the anonymity of "the Doctor" and "Mrs. X." is but thinly veiled. The article is hence of value to those interested in the study of this attractive but obscure subject.

The Adamson lecture for 1913, delivered by Prof. Bernard Bosanquet, in the University of Manchester, entitled "The Distinction between Mind and its Objects," consists in a brilliantly critical examination of the claims of Modern Realism—a twentieth-century philosophical school of thought, "which, whether unsatisfactory or not, is definitely new." Prof. Bosanquet reaches the conclusion that neither Realism nor its antagonist, Mentalism, is satisfactory *per se*. "What special use or gain," he asks, "is there in saying that knowledge is physical, when you have to subjoin an elaborate explanation admitting into this physical reality all the ignorance, errors, and illusions that the feeblest or most fantastic of minds could be guilty of? Or what gain for mentalism is there in treating knowledge as a part of your mind, when you must say in the same breath that it is only knowledge in virtue of the reality that appears in it? The double nature of knowledge, as the continuity of mind and reality, is the ultimate truth to insist on."

Two very interesting lectures on the present position of the sex-determination problem, by Profs. Correns and Goldschmidt, have been published by Borntraeger (Berlin), under the title "Die Vererbung und Bestimmung des Geschlechts" (pp. 149, price 4.50 marks). Prof. Correns deals with the subject largely from the botanical side, but devotes ten pages to the case of *Abraxas grossulariata*, and has numerous shorter references to other experiments with animals. Prof. Goldschmidt devotes the greater part of his section to an account of the cytological side of the subject. One of the difficulties in the study of this question has hitherto been that observations and experiments on the zoological and botanical side have been published largely in different periodicals, so that the worker on one side has been in some danger of overlooking results obtained on the other. For the zoological investigator, therefore, Prof. Correns's summary of our present knowledge of the phenomena of sex in plants is of great value. Prof. Goldschmidt gives a carefully chosen and lucid account of "sex-chromosomes," but the most valuable part of his section is probably the demonstration that there is no discordance between the cytological and experimental investigations; they are, in fact, complementary, and each confirms and amplifies the other. Both lectures are illustrated with excellent diagrams.

According to the April number of *Museum News*, the Brooklyn Museum has installed an antarctic exhibition. On the walls of the alcove in which it is displayed are hung a map of the south polar region and prints illustrative of antarctic life. Among the specimens are a group of king-penguins, a young sea-elephant, various petrels (including the miscalled Cape pigeon), an albatross, and a black-footed penguin.

From the report for 1912 we learn that the Zoological Society has had, on the whole, a successful and prosperous year, the number of fellows being the highest on record, while, despite the enhanced cost of provisions, the income shows a healthy excess over normal expenditure. During the year the president and council have directed their attention to the subject of zoological nomenclature, and have expressed the opinion that "an absolutely invariable application of the rule of priority . . . is not to the advantage of zoological science, and that they would welcome a modification of it, as, for instance, by the establishment of an authoritative fiat list of reserved names." The compilation of such a list formed, we believe, a part of the deliberations at the recent Zoological Congress at Monaco. Reference is made to the loss of the valuable services of the society's librarian, Mr. F. H. Waterhouse, who retired on a well-earned pension after forty years' work.

The annual report of the Norwich Castle Museum for 1912 records a decrease in the number of visitors on the previous year, due to the disastrous floods following on the unprecedented rainstorm in Norfolk on August 26 last, when the city of Norwich was practically isolated from the rest of the country. The success of the attempt to stimulate public interest, benefit the studious, and give point and purpose to the collections has again been evidenced by the large and appreciative audiences at the lantern lectures and demonstrations given at the museum under the auspices of the Norwich Museum Association. The subjects of lectures during the year 1912, to which a limited number of the general public were admitted free, were:—Food fishes, Prof. Garstang; poultry, Mr. Edward Brown; old-time methods of lighting, Mr. L. G. Bolingbroke; artistic glasswork, Mr. R. F. Martin; winged insects and their larvæ, Prof. F. V. Theobald; wild flowers and photography, Mr. H. E. Corke; and African big-game, Miss Cara G. Buxton. During the summer months a weekly exhibit of living specimens illustrative of nature-study was carried out by members of the association. A pleasing feature of the year is the interest evinced in the museum collections by the pupils from the council schools, 151 visits being arranged by the organiser of elementary education and 4789 pupils recorded.

Vol. xxxii. of the Observations made at the Royal Magnetical and Meteorological Observatory at Batavia refers to the year 1909. The preface, however, by the director, Dr. W. van Bemmelen, brings the history of the observatory down to 1912. It mentions the recent establishment of several mountain meteorological stations. Upper air and seismological observations have recently received considerable attention at Batavia, but are dealt with in different publications. The present volume comprises meteorology and terrestrial magnetism. Like previous volumes of the series, it contains numerous tables of meteorological data for the year. On p. 110 there is a summary of mean values based on from twenty-one to forty-six years. The annual variation of rainfall is unusually regular and marked, the monthly amount varying from 38 mm. in August to 332 mm. in January. As befits a station only 6° 11′ south of the equator, the annual variation of temperature is exceedingly small, the mean temperatures of the warmest and coldest months differing by only 1·04° C.

For some years magnetographs have been run at Buitenzorg, an electrically undisturbed station some twenty-five miles south of Batavia. There are two sets, one by Adie and a recent set by Töpfer and Schultze. Both sets record vertical force, but while the Adie set records as usual declination and horizontal force, the other set records the N.-S. and E.-W. components, and hourly values are given of these components in vol. xxxii. of the Observations made at the Royal Magnetical and Meteorological Observatory at Batavia. Declination at Buitenzorg is less than 1°, so that the diurnal variation of the horizontal force and its N.-S. component are almost identical, and the same is true of declination and the E.-W. component when the former is expressed in terms of force. Thus the departure from the ordinary procedure is more apparent than real. The introduction states that the magnetic character data for individual days are based entirely on the horizontal force, as being much the most disturbed element. The effects of magnetic storms are very readily traced in curves at the end of the volume showing the variation from day to day throughout the entire year in the absolute values of the several elements.

The *Verhandlungen* of the German Physical Society for March 30 contains a communication made to the society on March 14 by Dr. E. Grüneisen, on the effects of temperature and pressure on the electrical resistivities of pure metals. He finds on examination of the results for the resistivities of copper, silver, platinum, gold, and lead down to very low temperatures that for each of them the resistivity varies as the product of the absolute temperature and the atomic heat at constant volume. Assuming Wien's law that the number of impacts between electrons in the metal and metal atoms is proportional to the square of the amplitude of oscillation of the atoms, he deduces that the resistivity of a metal at constant temperature should decrease as the pressure is increased, at a rate which is of the same order as that found experimentally by Williams, Beckmann and others. Alloys the resistivities of which can be calculated correctly by the law of mixtures from the resistivities of their constituents follow the same law.

In the course of his address as president of the Institution of Mechanical Engineers, Sir H. F. Donaldson referred, among other matters, to the value of systematic research in engineering works. For example, in the heat treatment of steel, no amount of rule-of-thumb or the possession of an expert eye could ever ensure uniformity in results which vary enormously with but slight alterations in temperature; some system of pyrometry is called for as a protection against failures. The president suggests the establishment of an engineering research committee with a view to coordinate the work, to prevent overlapping, to ensure the carrying out of individual researches to absolute results, and to publish such results. In time the committee would acquire so large an accumulation of data as to make it the first source upon which the public would draw for information as to any research already effected, and as to the possibilities of extending research on lines which might seem to require investigation. The success which has attended the engineering standards committee might be regarded as holding out possibilities of success for an engineering research committee.

THE Cambridge University Press will publish shortly a book on "Rubber and Rubber Planting," by Dr. R. H. Lock, dealing with the history of the use and cultivation of rubber, its botanical sources, the botanical physiology of rubber and latex, the diseases, chemistry, and manufacture of rubber, and with rubber planting.

THE April edition of the catalogue of second-hand scientific instruments which are for sale or hire at the establishment of Mr. Charles Baker, 244 High Holborn, London, W.C., has reached us. The list includes some 2000 items, and an examination of the catalogue shows that customers can obtain second-hand practically every class of scientific instrument. Every instrument in the second-hand department is guaranteed to be in adjustment.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR MAY:—

May 1. 20h. 24m. Mars in conjunction with the Moon (Mars 0° 48′ S.).
4. 12h. 0m. Venus in conjunction with the Moon (Venus 1° 26′ N.).
5. 9h. 0m. Jupiter stationary.
7. 10h. 35m. Saturn in conjunction with the Moon (Saturn 6° 20′ S.).
10. 21h. 19m. Neptune in conjunction with the Moon (Neptune 5° 21′ S.).
12. 9h. 0m. Uranus stationary.
13. 17h. 0m. Venus stationary.
18. 3h. 0m. Mars in perihelion.
23. 10h. 23m. Jupiter in conjunction with the Moon (Jupiter 4° 56′ N.).
25. 0h. 50m. Uranus in conjunction with the Moon (Uranus 3° 38′ N.).
29. 1h. 0m. Saturn in conjunction with the Sun.
30. 15h. 0m. Venus at greatest brilliancy.
31. 2h. 25m. Mars in conjunction with the Moon (Mars 3° 9′ S.).
31. 6h. 31m. Mercury in conjunction with Saturn (Mercury 2° 4′ N.).

THE SUN'S POLAR AND EQUATORIAL DIAMETERS.—The *Annales de l'Observatoire Astronomique de Lô-sè* (China), tome vi., contains three parts, the second of which is devoted to an account of a photographic study of the polar and equatorial diameters of the sun as deduced from observations made during the period of 1905–10. The investigation was carried out by Le R. P. S. Chevalier, S.J., and had for its first object the discovery, if possible, of variations in the mean diameter of the sun. The results obtained may be briefly summarised as follows:—There is a difference between the polar and equatorial diameter, the former diameter being the greater of the two. This difference does not seem to be constant, and the variations indicated cannot, according to the author, be attributed to errors of observation, and, so far as he can see, must be due to the sun itself. Here are the values for each of the six years:—

Year		Pol.-Equat.
1905	...	+0·07″
1906	...	+0·17″
1907	...	+0·31″
1908	...	+0·29″
1909	...	+0·13″
1910	..	+0·17″
Mean	...	+0·19″ ±0·015″.

With regard to the value of the mean diameter, he obtains 31′ 59·93″, which differs somewhat from that usually adopted, namely 31′ 59·26″, on the authority of Dr. Auwers, after a series of measures with the heliometer. While Chevalier points out that there is evidently a systematic error in one of the two sets of measures, and it may be in the photographic series, but he has not been able to trace it, yet, he asks, is it quite certain that it is excluded from the heliometric series, these measures all being made with instruments of the same type and short focal lengths?

UNITED STATES NAVAL OBSERVATORY.—We have received a copy of the annual report of the Naval Observatory for the fiscal year 1912. This modest and admirably concise account of the year's work of three active and important departments, corresponding to our Greenwich and Kew observatories and the Nautical Almanac Office, merely forms appendix No. 2 to the annual report of the chief of the Bureau of Navigation. The department of the Nautical Almanac, under the direction of Prof. W. S. Eichelberger, U.S. Navy, who represented the observatory at the Congrès International des Ephémérides Astronomiques, held at Paris in 1911, has expressed, under authority of the U.S. Congress, its willingness to adopt the programme of exchanges of data recommended at the Paris meeting. Particulars are given of various significant changes it is proposed to make in the American Ephemeris and Nautical Almanac, beginning with the edition of 1916. Considerable progress appears to have been made in the adoption of the Sperry gyro-compass in the U.S. Navy; six battleships and two submarines are supplied with sets, and ten additional sets have been ordered. The ordinary magnetic compass is still retained in ships fitted with gyro-compasses. We are informed that the noon signal has been transmitted by radio-telegraphy to ships at sea since so long ago as January, 1905. Special attention is being devoted to making improvements in the instruments of nautical astronomy. Among a long list of novel apparatus we note that a gyroscopic artificial horizon has been tried.

Distribution of Spectroscopic Double Stars.—In the April number of *L'Astronomie*, Prof. P. Stroobant, of the Observatoire Royal de Belgique, using Campbell's second catalogue of spectroscopic binary stars, published in 1910, shows that representatives of this class of stars are most abundant in the neighbourhood of the Milky Way—a similar result to that already found by E. Zinner for variables of the Algol type, to which the spectroscopic doubles bear a strong analogy. Stroobant shows that in this condensation the stars in question obey the law of distribution found by Pickering for the helium stars, being almost precisely proportional to the number of class B stars amongst the binaries.

JADE IN CHINESE SECULAR LIFE AND RELIGION.[1]

The sumptuous monograph on the Bishop collection in New York entitled "Investigations and Studies in Jade" is so rare as to be inaccessible, and consequently there is room for another work on the subject. The authorities of the Field Museum of Natural History of Chicago were well advised to entrust the Blackstone expedition to Tibet and China to Dr. B. Laufer, and to encourage him to describe the jade objects he collected in a comprehensive monograph. As a matter of fact, his specimens largely supplement, and only slightly duplicate, the wonderful collection in New York, as most of them were exhumed from ancient graves, whereas the majority of the specimens in the Bishop collection are modern. Similarly, his monograph supplements the other; he does "not deal with jade for its own sake, but as a means to a certain end; it merely forms the background, the leading motive, for the exposition of some fundamental ideas of Chinese religious concepts which find their most characteristic expression and illustration in objects of jade."

The oldest Chinese term for jade is just as general and comprehensive as our word, and includes nephrite, jadeite, bowenite, and occasionally serpentine, &c.; at present only the first two are acknowledged as true jade by the Chinese. The jades of the Chou and Han dynasties are made of indigenous material from the Shensi province, but the supply was exhausted long ago, and about the beginning of the Christian era Turkestan became the chief source for the supply of jade to China, Yünnan and Burma also contributing later. The importance of the trade in jade can be realised when one remembers that "for the last two millenniums Turkestan has furnished to China the greater supply of her jade, wrought and unwrought, and the most colossal boulders of the mineral were constantly transported from Khotan to Si-ngan-fu and Peking, over a trade route unparalleled in extent and arduousness in Europe, and requiring a four to six months' journey."

In dealing with stone implements, Dr. Laufer points out that none of Palæolithic type have as yet been found; all are polished, they are found scattered in certain parts of the country, and are generally scarce. In the present state of our knowledge it is not justifiable to speak of a Stone age in China, and still less of a Stone age of the Chinese, since at the time when they were settling and spreading they were already in possession of metal implements. Four centuries ago Chinese antiquaries spoke of "thunder-axes," and in the eighth century they were described as "stones of the God of Thunder"; sometimes they were made of jade.

The ancient spade-shaped stone implements of the Kolarian-Mon peoples were reproduced in jade and bronze in the Han period, but in the earlier Chou period there was a bronze currency of similar shape. The first sovereign of the Han dynasty (B.C. 206–195) announced his accession to the throne by sacrificing to heaven an engraved jade tablet, a custom which continued for a thousand years or so; these writing tablets were developed from the ancient bamboo slips or wooden splints which served as writing material before the invention of paper.

There is a correlation between the jade objects used in nature-worship and those buried in the graves of the Chou era. Heaven, earth, and the four quarters were six cosmic powers or deities, and the jade carvings serving their worship were nothing but the real images of these deities under which they were worshipped. Anthropomorphic conceptions are lacking in the oldest notions of Chinese religion, and therefore no anthropomorphic images are known. The shapes of these images are geometric in design: a jade disk, round and perforated, representing heaven, a tube surrounded by a cube earth, a semicircular disk the north, &c.

a *b*

Fig. 1.—*a*, Plain type of tongue-amulet; *b*, tongue-amulet carved in shape of realistic cicada—upper face; *c*, tongue-amulet showing conventionalised form of cicada. From "Jade: A Study in Chinese Archæology and Religion."

In addition to the use of jade in religious worship its employment in coins, seals, and personal ornaments is fully dealt with, and a very interesting account is given of the various kinds of jade amulets for the dead, other objects being buried besides these. The belief prevailed that jade had the property of preserving the flesh of the body and keeping it from decay, and it was also believed that immortality could be obtained by eating from bowls made of a marvellous kind of jade called "the perfection of jade." Among the amulets worn by the corpse, those placed on the tongue were the most important, and were shaped in the outline of that organ; many are in the form of a cicada, doubtless as an emblem of resurrection; indeed, the

[1] Field Museum of Natural History, Anthropological Series, Publication 154. "Jade: A Study in Chinese Archæology and Religion." By B. Laufer. Pp. xiv+370+68 plates. (Chicago, 1912.)

philosopher Wang Ch'ung said, "The vital spirit of a dead man leaving the body may be compared to the cicada emerging from the chrysalis." There were also eye, lip, and umbilical amulets.

Dr. Laufer has a very extensive knowledge of Chinese literature and of folk-usage and beliefs, and as he has discussed the matters studied with Chinese savants, we have a remarkably complete and discerning monograph, which will appeal alike to connoisseurs, artists, ethnologists, and students of comparative religion and folklore. There are sixty-eight plates, six of which are coloured, and 204 text figures, most of which are reproductions of Chinese drawings. The Field Museum of Natural History is to be congratulated on the publication of a monograph worthy of its most important and interesting collection of jade objects.

A. C. HADDON.

FIG. 2.—Incense-burner carved from white jade in open work, Ming period. From "Jade: A Study in Chinese Archæology and Religion."

TECHNICAL EDUCATION IN INDIA.[1]

A REPORT on the results of an inquiry into the relation of technical instruction in India to the actual requirements of employers, which has recently been published, contains some valuable suggestions on the industrial outlook in that country. The inquiry is, however, strictly limited in scope. The report is not concerned with the general question of technical education, nor with the organisation or improvement of local industries; it deals with the more restricted and definite question of the value of the instruction now provided in Indian technical institutes in qualifying the students of those institutes to undertake positions as managers, heads of departments, foremen, and assistants in engineering, and in some few other industrial works.

Extensive inquiries have been made from the heads of engineering firms in different parts of India and also from the directors of instruction and the managers of some of the principal schools and technical institutions, and the results of these inquiries are embodied in certain definite recommendations, which have for their object the bringing into closer relation of the teaching of the schools with the actual needs of employers. The writers of the report, whilst giving due weight to the views of British engineers and educational authorities, have wisely recognised the fact—too often overlooked—that the conditions of industry differ very widely in India and in Western countries, and that the character, disposition, and aptitudes of native students must be considered in any proposals as to their education and training. The endeavour to impose upon institutions in India methods of instruction which may be well adapted to European students has produced results which are by no means satisfactory, and those who approach the problem of education from a scientific point of view realise that the character of the student, which is a product of his environment, must be considered in all educational schemes, and that the conditions of his training must be adapted to his habits and surroundings. This fact is recognised by the writers of the report when, at the outset of their inquiry, they state:—"It is useless training a man in mechanical engineering who will not take off his coat and work, whose physique will not stand the strain, or whose social customs make manual work repugnant."

The efforts already made to organise and develop education in India have clearly shown that the native student has a strong preference for studies dealing with the theories and principles of his subject over those demanding severe practical work or protracted scientific investigation. In many of the higher branches of handicraft the Indian is proficient, and it is a matter of some regret that greater efforts have not been made to develop technical instruction along lines which would have improved, and given greater artistic value to, many of the native industries. That suggestion, however, opens up a subject beyond the scope of the inquiry with which the report deals. The main object of the Commissioners was to ascertain what arrangements can be made for systematic co-

[1] Report on the Inquiry to Bring Technical Institutions into Closer Touch and More Practical Relations with the Employers of India. By Lieut.-Col. E. H. de V. Atkinson, R.E., and Tom S. Dawson. Pp. 100. (Calcutta, 1912.)

ordination between the work of technical institutes and the needs of employers with a view to active cooperation in the interests of the students and employers and for the general welfare of the country.

To effect this desirable end, great importance is wisely attached to affording to students ample facilities for practical work, not only in school laboratories and school shops, but under strictly commercial conditions in engineering and other industrial firms. Among the causes of the partial failure of Indian students to obtain suitable employment after leaving the technical institute some of the employers who were consulted state that "in most cases students from technical institutions will not work with their hands, will not observe factory hours, ask too high wages for learning their practical work, and generally think they know everything."

It is a fact that in their desire to obtain employment, whether as engineers or civil servants, Indian students undoubtedly attach too great a value to their school teaching, and the Commissioners recommend that school instructors and school managers should make it clear to their students that they are totally unfit for any position of authority immediately on leaving the institute, and must gain, under appropriate conditions of discipline, practical acquaintance with the details of the work in which they hope to be occupied. "Otherwise," they state, "there will always be a large number of men who fail to go further than the end of their college course." This is sound advice, which is not altogether inapplicable to British students. It is satisfactory to gather from the report that the writers are of opinion that Indians "if possessing the necessary character, theoretical knowledge, and practical experience, have more than equal chance of employment in India with Europeans." This statement will be read with equal gratification by those who are responsible in this country for the government of India as by the natives concerned.

Among the valuable recommendations set forth in the closing pages of this report, the importance of practical work is repeatedly emphasised. "The education given in the institute," we are told, "should be essentially practical, be capable of being applied commercially, and not of such high scientific character as is often considered necessary in the West." It is also pointed out that the "best method of training men in mechanical and electrical engineering to meet the existing demand is by a course at a well-equipped institute, followed by an apprenticeship in works."

India is waking up to the necessity of developing new and important industries. For the supply of the machinery needed to equip the increasing number of cotton mills now being erected in India, there will be a growing demand, and endeavours are being made to meet this demand by Indian enterprise and skill. The number of bleaching and dyeing works must be gradually increased with the development of the textile industries; and if only qualified students can be found who have received an adequate training in the technical institutes, new fields of employment will be opened up for native workers.

The report shows how the school may help the factory, and how the factory may offer a continually increasing number of remunerative posts to the trained students of the technical school. In addition to the general recommendations, the report contains useful suggestions for adjusting facilities for technical instruction to meet the demands of employers in the various provinces of India.

RESEARCHES IN RADIO-ACTIVITY.

SEVERAL communications from the Radium Institute at Vienna are before us, and a few of the most noteworthy are here mentioned.

In one of the recent communications from the institute Dr. O. Hönigsmid gives the result of a fresh atomic weight determination from the bromide, which confirms the value, 225·95, previously obtained from the chloride. Two determinations by conversion of the chloride into the bromide and *vice versâ*, the method adopted by Whytlaw-Gray and Sir W. Ramsay, also gave practically identical results. In conjunction with E. Haschek, a spectrographic examination of the preparations for barium was made. The barium line 4554·24 was not seen, and it was calculated from the effect of the addition of known small amounts of barium that the standard preparations could not have contained more than 0·004 per cent. of barium. This settles the question of the purity of the international radium standard, and of the true atomic weight of radium. It is characteristic of the time and of the accurate researches radio-activity has called forth, that the atomic weight of radium should now be one of the best-known constants, and far more certain than that of uranium and thorium.

In another communication, Dr. F. Paneth finds that polonium resembles a colloid in that it does not pass appreciably through animal membranes or parchment paper. Radio-lead may readily be separated from polonium by dialysis, the crystalloid salts of lead readily passing through the membrane and carrying the radio-lead with them in unaltered proportion.

Some further results of H. Molisch bring out the harmful effects of the radium emanation on growing plants when it is present above a certain degree of concentration. In lesser amounts a slightly favourable action on the growth is sometimes observed. The injury is a permanent one, the organs of the plant being affected and the leaves falling off. It appears to work like a poison chemically upon the cells, and considering the minute absolute amount of the emanation, there can be very few poisons which would produce in such small quantity so far-reaching destructive effects.

A. Brommer discusses the influence of the partial solar eclipse of April 17, 1912, on atmospheric electrification. During the first phase of the eclipse a well-marked diminution occurred in the number both of positive and negative ions in the atmosphere, the latter decreasing more rapidly than the former, so that an initial excess of positive ions was converted into a deficit. As the sun's disc again became uncovered, the number of ions increased and regained nearly their initial values, establishing a direct influence of sunlight on the ionisation of the atmosphere.

Exner and Haschek describe an unsuccessful attempt to find spectroscopic evidence of the existence of ionium in the thorium-ionium preparations separated from ten tons of Joachimsthal pitchblende by A. v. Welsbach. A similar attempt, with the same negative result, by A. S. Russell and R. Rossi, with the Royal Society's ionium preparation, is described in a recent number of the Proceedings of the Royal Society (p. 478). In view of the estimated period of ionium being from forty to one hundred times as long as that of radium, both these preparations should have contained a considerable proportion of ionium, and the failure to detect in their spectra a single line other than those due to known substances raises very important and fundamental questions.

A. Kailan, in three papers, deals with the influence of ultra-violet light and of the penetrating rays of radium on various organic and inorganic compounds, and Meyer and Przibram discuss, among other phenomena, the effect of exposure to radium rays in increasing the "Hallwachs effect" in minerals.

Meyer and Paneth have undertaken a re-investigation of the proportion of α rays in a uranium mineral due to the uranium and radium respectively, which they find to be 100 : 57·3, instead of 100 : 45, as found initially by Boltwood. The new ratio agrees perfectly with the present view that uranium consists of two elements, uranium I. and II., each emitting one α ray per atom disintegrating, of ranges respectively 2·5 and 2·9 cm. of air at 15°, with which the older ratio was seriously in disagreement.

Lastly, Hess deals with the heat generated by a pure radium salt at the moment of its preparation, when it is free from the products of disintegration, and finds it to be 25·2 calories per hour per gram of radium (element). In the course of a month, in which the first four products accumulate to the equilibrium quantity, the heat generated increases by 107·1 cal. per hour, the total (for α and β rays, and 18 per cent. of the γ rays) agreeing perfectly with his previous measurements in collaboration with Prof. Meyer on a different preparation. As an example of the perfection to which our knowledge of the processes of atomic disintegration has been brought, and to which it would perhaps be difficult to find a parallel elsewhere in the molecular sciences, it may be mentioned that the figure 25·2 calories per hour per gram of radium agrees, within 1 per cent., with the value deduced from Rutherford's direct measurements of the number, mass, and velocity of the α particles expelled by radium, taking into account the kinetic energy of recoil. An analogy to this would be a determination of the "heat-drop" of steam by counting the number, measuring the individual mass, and determining directly the velocity of the molecules leaving a turbine-jet. F. S.

SCIENTIFIC WORK OF THE CENTRAL CHEMICAL LABORATORY OF THE ITALIAN CUSTOMS.

THE report of the year's work of the Central Chemical Laboratory of the Italian Customs at Rome (*Annali del Laboratorio Chimico Centrale delle Gabelle*, vol. vi., 1912, pp. xxxvii+707), under the direction of Prof. V. Villavecchia, which has recently been issued, contains an introductory article by the director on the history of its twenty-five years' activity since its inauguration in 1885. In this period 225,679 analyses have been made, and 1524 special reports prepared for various Government departments, whilst 127 original papers have been published in the *Annali* issued from the laboratory. Recently a museum of commercial products and raw materials has been established in connection with the Central Laboratory, care being taken to ensure the genuine character of all the specimens, so that they can be used as standards of reference by the Government chemists; an account is given in the report of the 32,382 samples collected for this museum, and a description of the building.

In the present report some of the most important original contributions are as follows. I. Barboni has investigated comparatively the different methods which have been used for the analysis of commercial calcium citrate, and reports on their suitability. A. Capelli, in examining the alkaloids contained in maté, has been able to separate only caffeine, although the statement has been recently made that caffeine is present only in traces, the principal alkaloid being matteine. There is a series of papers by R. Belasio on the electrolytic estimation of zinc, the separation by electrolysis of iron and manganese, the analysis of white metals and tinfoil, the detection of antimony and of tin in metallic alloys, and a description of the electrolytic methods of analysis in use in the laboratory of the *Gabelle*. Among papers dealing with organic analysis the following may be cited:—G. Testoni, the estimation of sucrose in the presence of other sugars; E. Castaldi, the Halphen test for cottonseed oil; L. Settimj, a characteristic colour reaction for soja-bean oil; S. Camilla and C. Pertusi, the detection and estimation of the xanthine bases in cocoa, tea, and coffee; V. Villavecchia and A. Capelli, the quantitative estimation of cotton, wool, and silk in mixed fabrics.

Independently of its work of routine analyses for the control of commercial and dutiable articles, the laboratory is carrying out valuable work in investigating the many different and often conflicting methods of analysis in current use, and, when necessary, devising new processes to meet freshly arising needs.

THE HYDROMETER AS AN INSTRUMENT OF PRECISION.[1]

MR. J. Y. BUCHANAN publishes in the Transactions of the Royal Society of Edinburgh (vol. xlix., part i., 1912) the results of extended researches on the specific gravity and the displacement of some saline solutions. The memoir, which occupies 225 quarto pages, deals with the densities and variations in densities of certain groups of saline solutions; but although the results obtained are themselves of interest and value, the importance of the work centres rather in the detailed study of the use of the hydrometer as an instrument for work requiring a high degree of accuracy. This importance, of course, arises mainly from the fact that ever since the days of the *Challenger* expedition, Mr. Buchanan has been the principal champion of the hydrometer method for determining the specific gravities of samples of sea-water for purposes of oceanography, and that the method has now for many years been practically disused by most oceanographers.

Two forms of hydrometer are described. In the "closed" type—that ordinarily used for, *e.g.*, sea-waters—the weight of the instrument is varied by adding to or subtracting from a number of weights placed on the top of the glass stem of the hydrometer. The additional weights are obviously limited by questions of stability, for if too much weight is accumulated at the top of the stem the whole instrument will tend to capsize. Solutions of high density are therefore treated with an instrument of the "open" type, in which the stem is left open at the top instead of being hermetically sealed, and the paper scale is replaced by one etched on the stem itself. The internal ballast can then be altered by varying the amount of mercury or the number of lead pellets, as the case may be, and the final adjustment by weights at the top of the stem made without risk of the instrument swinging out of the vertical.

Every worker with the closed type of instrument (that used on board the *Challenger*) knows that the real difficulty is not to get consistent results, but to get accurate results, or results which will either agree with those obtained by other methods or differ from them in some way which can be accounted for. Much labour has been expended by many investigators in efforts

[1] "Experimental Researches on the Specific Gravity and the Displacement of Some Saline Solutions." By J. Y. Buchanan, F.R.S. (Trans. R.S.E., vol. xlix., part i., 1912.) Pp. 227. (Edinburgh: Neill and Co., Ltd., 1912. Price 7*s*. 6*d*. net.

to reconcile the differences observed. Mr. Buchanan, however, does not enter into the question, but re-states the position he took up in a paper read at the International Geographical Congress in 1895, to the effect that this type of hydrometer gives not comparative but absolute results, and is "a pyknometer where the volume of liquid *excluded* up to a certain mark is weighed instead of that *included* up to a similar mark."

GERMAN METEOROLOGICAL REPORTS.

THE organisation reports of (1) the Royal Prussian Meteorological Institute (Berlin) and (2) the Deutsche Seewarte (Hamburg) for the year 1912 have been recently published. The operations of these establishments are quite distinct; the institute dates from 1847, as a department of the Statistical Bureau, under Dr. W. Mahlmann, to whose life and work a special article is devoted in the report for this year. The work of the institute (which became an independent meteorological organisation in 1886) consists to a considerable extent of special scientific researches which appear in the *Abhandlungen* and elsewhere, and in the preparation and publication of the observations made at a large number of stations, separate departments dealing specially with meteorology, rainfall, and thunderstorms. It also controls the work of Potsdam Observatory, which undertakes various branches of geophysical investigation. Among the various discussions in this year's report we may mention an interesting inquiry into the Thuringian deluge of May, 1613, by Dr. Hellmann (director).

The Deutsche Seewarte (Hamburg) may be said to date from 1867, under Dr. W. v. Freeden, and was established as a Government institution in 1875; its great work, which is well known to our readers, will always be associated with the name of Dr. v. Neumayer. It deals with all branches of maritime meteorology and weather telegraphy, and controls a limited number of meteorological and storm signal stations. Among its many useful publications may be mentioned (1) monthly meteorological charts of the North Atlantic, observations at many oversea stations and colonies, a laborious and useful atlas of daily synchronous weather charts for the North Atlantic (in conjunction with the Danish Meteorological Institute), also scientific discussions in the *Archiv der Deutschen Seewarte* and elsewhere. During the year 1912 it received 4391 months' observations taken on board ship, and made 351 ascents by kites, captive and pilot balloons, in connection with the exploration of the upper air.

ORNITHOLOGICAL NOTES.

ACCORDING to the Journal of the South African Ornithologists' Union for December, 1912, a special effort is being made to arouse interest in the dates of arrival and departure of the local migratory species, such as the bee-eater, red-legged kestrel, swallow, and golden oriole. With this object in view, school teachers willing to assist are to be admitted to associate membership at a greatly reduced subscription.

Mr. Gregory Mathews is to be congratulated on the completion, with No. 8, of the first volume of *The Austral Avian Record,* this part including a notice of birds described by Gould from Norfolk, Lord Howe, and Philip Islands.

It has long been known that certain kinds of birds—especially hornbills—are in the habit of periodically shedding and casting the lining membrane of their gizzards. According to a letter from Mr. D. Macintyre published in *The Field* of March 31, and an article by Mr. H. H. Smith in the April number of *British Birds,* the curlew must be added to the small list of species in which this strange act occurs.

In the January issue of *The Ibis* Dr. Sclater contrasts the new "Hand-List of British Birds," by Dr. Hartert and others, with the list issued by the British Ornithologists' Union in 1883, and points out that out of the 376 species included in the latter the names of no fewer than 200 would have to be changed if the nomenclature of the "Hand-List" were accepted. Dr. Sclater considers it undesirable to take the tenth, in place of the twelfth, edition of the "Systema Naturæ" as the basis of our zoological nomenclature, and points out that according to the Stricklandian code "tautonyms" are prohibited, while liberty to correct mistakes and bad grammar is permitted. "If," he adds, "we take Latin for the language of science, we are surely bound to follow its grammatical rules."

PROMOTION OF RESEARCH BY THE CARNEGIE INSTITUTION OF WASHINGTON.

THE Year Book for 1912 of the Carnegie Institution of Washington has now been issued. The record of work accomplished contained in its pages shows there has been no diminution in the efforts of the trustees to secure a wise expenditure of the funds placed at their disposal for the advancement of research in science.

The following list shows the departments of investigation to which the larger grants were made by the trustees and the amounts allotted from these grants by the executive committee during the year:—

	£
Department of Botanical Research	7,600
Department of Economics and Sociology ...	2,500
Department of Experimental Evolution ...	7,500
Geophysical Laboratory	15,000
Department of Historical Research	5,300
Department of Marine Biology	3,600
Department of Meridian Astrometry	5,200
Nutrition Laboratory	9,700
Division of Publication	2,000
Solar Observatory	51,000
Department of Terrestrial Magnetism ...	19,600
	129,000
Transferred from Nutrition Laboratory to unappropriated fund	1,000
	130,000

Numerous minor grants were made, amounting to very nearly 40,000*l.*, and grants for publication authorised during the year reached a total of about 8600*l.* During the year 1912 the income of the institution was almost 250,000*l.*, and the total expenditure some 229,600*l.*

The following extracts from the *résumé* of the investigations of the year included in the report of the president of the institution, Dr. Robert S. Woodward, will give some indication of the work which has been inaugurated and encouraged:—

Although the departments of investigation, like the institution as a whole, have fallen short of popular expectations in the rapidity of their growth, it now appears plain, in the light of their actual experience, that this growth has been somewhat too rapid for safety. Along with this rapid growth and with the signal success of the departments in their several fields of research, there are now coming also numerous requests for cooperation with other organisations and with individuals. But while these requests are in general gratifying and often praiseworthy, they present some obvious hazards. There is need, therefore, of constant caution against the dangers of undue expansion and affiliation which lead to dissipation of effort and resources. It should be kept in mind that concentration on definitely limited programmes, continuity of effort, and energetic assiduity are the factors most essential to progress in the domain of research.

The geographical range of the work of the department of botanical research, which centres in the Desert Laboratory at Tucson, Arizona, has been extended during the past year to include certain portions of the deserts of northern Africa. Studies have been continued at the Desert Laboratory, at the Carmel Laboratory on the California coast, at Salton Sea, and at various substations where observations are made on the phenomena presented by plants under strikingly varying conditions. One of the most important investigations undertaken during the past year is that of a comprehensive study of the large and highly diversified family of cactus plants.

The advances made by the department of experimental evolution during the past year have been chiefly along the lines of studies in cytology, in the chemistry of pigmentation, in the factors of mutation, and in the problems of human heredity. These studies have been carried on by aid of experiments with plants and animals and by aid of rapidly accumulating statistical data concerning human traits and their transmission through successive generations. The director has been able to give much of his time to studies in human heredity by reason of his connection with the Eugenics Record Office. Very interesting chemical studies have been carried on by Dr. Gortner, a member of the staff, in respect to the chemical nature of pigments which determine colour characteristics, especially of the plumage in birds, of the wool in sheep, and of the skin in men. Dr. Shull has continued his fertile studies into the heredity of plants, including further investigations into the connection between heredity and environment in the case of corn. These further studies confirm his earlier conclusions and show also that the hereditary traits of different strains are maintained irrespective of environmental influences.

Two specially noteworthy publications of the geophysical laboratory have been issued during the year by the institution, namely No. 157, "High Temperature Gas Thermometry," and No. 158, "The Methods of Petrographic-Microscopic Research." The purpose of the first of these was to give an account of the apparatus and methods for accurate measurement of the critical temperatures incident to mineral combinations; and the object of the second is to place, so far as practicable, microscopic study of minerals upon a quantitative basis.

Special attention is directed in the director's report to extended studies on quartz and other forms of silica, which is the most widely diffused ingredient in rock masses; to further experiments on the conditions of association of the three oxides, lime, alumina, and silica, which in addition to being the commonest components of igneous rocks, are also incidentally the three principal ingredients of the so-called Portland cement; to mineral sulphides, which are often of great economic importance; and to mineral and rock densities.

Perhaps the most interesting of the more recent investigations of the laboratory are those of the physics and chemistry of active volcanoes undertaken tentatively a year ago and pursued with very gratifying success during the past summer. It has proved practicable for members of the staff to descend into the crater of Kilauea and to collect considerable quantities of gas as it emerged from the liquid lavas of the crater. Specimens of gases were collected in glass tubes without contamination from the air, and these have been brought to the laboratory at Washington for detailed study. There seems little reason to doubt that the phenomena of vulcanism will be ultimately revealed by the methods, apparatus, and technique developed by the staff of the laboratory.

The independent transportation facilities furnished by the new vessel, *Anton Dohrn*, and the repairs and improvements to the laboratory completed a year ago, have proved highly advantageous to the department of marine biology. By means of the *Anton Dohrn* the entire Gulf and West Indian region becomes open to investigation by the department. The director records with appreciation a gift to his fleet by Hon. John B. Henderson, of Washington, D.C., of a 23-ft. 6-h.p. launch, which has already proved a very useful adjunct in the diversified work of the department, since many different investigations are carried on simultaneously by different individuals at the laboratory headquarters. During February and March of the current year the director established a temporary laboratory at Montego Bay, Jamaica, a region which sustains important biological relations to the vicinity of the Tortugas group of islands. The director of the department has issued, as No. 162 of the publications of the institution, an additional volume of his series on the jelly-fishes of the world, the title of this volume being "Ctenophores of the Atlantic Coast of North America."

Special attention has been given in the department of meridian astrometry to the reduction of the meridian observations made at San Luis, Argentina. The determination of the two coordinates of stars from this work, namely right ascension and declination, have proceeded simultaneously. The assignment of stellar magnitudes, however, must await the photometric determinations which have been made at San Luis since the meridian measurements were completed. Late advices announce that it will be completed by the end of the present calendar year. The great quantity of priceless observational and derived data accumulated by the department rendered it imperative that special provision should be made for their safe storage. Accordingly the executive committee authorised the construction of a fireproof vault within the walls of the Dudley Observatory. This vault is now ready for occupation and the records will be placed therein as soon as practicable.

One of the most interesting of the many investigations under way in the nutrition laboratory during the year is that of the metabolism of a subject who underwent a prolonged fast, extending to thirty-one days without food, and drank only distilled water during this time. This investigation required the cooperation of a number of chemical, pathological, and psychological experts. A detailed report on this elaborately observed experiment is at present in preparation. Another noteworthy investigation of the year is that on metabolism during severe muscular work, undertaken by Dr. E. P. Cathcart, of the University of Glasgow, who was a research associate of the institution during the winter of 1911–12. Amongst other important results of the latter research is the measure it affords of the mechanical efficiency of man. An account of this investigation is likewise in preparation for publication.

Highly effective progress has been made by the department of terrestrial magnetism during the past year in its magnetic survey of the globe. By means of the non-magnetic ship *Carnegie* it is now easier to make a magnetic survey of the ocean areas than of the land areas, for the former are now more readily accessible than the latter. At the end of the preceding fiscal year the *Carnegie* was at Batavia, Java. On November 21, 1911, she set sail for an additional circuit of the Indian Ocean, when she proceeded to Manila, Philippine Islands, where she arrived February 3, 1912. From Manila she proceeded to Suva, thence to Tahiti, and afterwards to Coronel, Chile. During the fiscal year she traversed about 28,000 miles. Her courses are arranged to intersect as frequently as possible her own previous tracks, those of the *Galilee*, and those of previous expeditions on which magnetic elements were observed. Valuable checks on the determinations of these elements are thus secured, and in case of considerable intervals between the dates of different determinations, data for secular variation of the magnetic elements are also obtained. As related in the report of a year ago, unexpectedly large errors were found in the best magnetic charts of the Indian Ocean and for some parts of the Pacific Ocean.

Observations have been continued simultaneously on land areas, embracing portions of five continents and about twenty different countries. Many noteworthy series of transcontinental stations have now been completed. Of these, one extending across the entire continent of South America, beginning at Para, at the mouth of the Amazon, and extending to Callao on the Pacific coast, by way of the Amazon and Ucayali rivers and Lima, has been finished during the past year.

The past year has been one of minimum sun-spot activity; but effective progress has been made in many other branches of solar and stellar research undertaken by the solar observatory. The wide range of this work may be indicated by the fact that the results of the investigations of the year are summarised by the director under thirty-five different heads. The new tower telescope has been completed, and important auxiliary apparatus has been added to the equipment of the 60-in. reflector. A fireproof office building, which will afford adequate quarters for the staff and safety for the original records and photographic plates of the observatory, has been constructed and made ready for occupancy during the year.

The 150-ft. tower telescope with its spectrograph and spectroheliograph has been tested and found to be quite up to expectations. The 60-in. reflector has proved increasingly effective in the wide variety of work undertaken with it. Between forty and fifty new spectroscopic double stars have been found; and amongst the many stars the radial velocities of which have been measured is one which surpasses all others hitherto observed, its velocity being about 150 miles per second.

Two eminent research associates, namely Prof. Kapteyn, of Groningen, and Prof. Störmer, of Christiania, have taken part in the work of the observatory during the year.

The laborious task of shaping and testing the glass disc for the proposed 100-in. telescope has proved a disappointment in showing that this disc, which was accepted provisionally from the makers several years ago, will not answer the requirements. It appears possible that some expedients may be adopted to overcome the instability of this disc; but the probability that it may be made to work satisfactorily is small. In the meantime the makers of such large discs have not succeeded in making one of sufficient uniformity in density. In view of these difficulties the director is disposed to try a thinner disc if one can be found possessing the requisite degree of homogeneity. Thus this project must suffer further delay, although it is practically certain that the difficulties presented may be ultimately overcome.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The subject selected for the Adams prize in 1914 is "The Phenomena of the Disturbed Motion of Fluids, including the Resistances encountered by Bodies moving through them." A theoretical re-discussion of the problem of fluid resistance may be undertaken, either in general or in simple cases, in the light of the experimental knowledge regarding the resistances and the nature of the broken motion of the fluid which is becoming available in the publications of the aëronautical laboratories of various countries. Information has been accumulating regarding the nature and mode of travel of meteorological atmospheric disturbances, such as cyclonic movements and line squalls, the propagation of minute waves of barometric pressure, and the nature of the lower boundary of the upper calm region of the air. A dynamical discussion of these topics, or of simpler problems in illustration of them, might be undertaken. The prize is open to the competition of all persons who have at any time been admitted to a degree in the University of Cambridge. The value of the prize is about 220*l*. The essays must be sent to the Vice-Chancellor on or before the last day of December, 1914.

The Linacre lecture at St. John's College will be delivered by Dr. Norman Moore, on Tuesday next, May 6, on the physician in English history.

The professor of botany has recently received for the botanical museum a collection of 100 water-colour studies of Italian and other South European flowering plants from Mrs. Latimer-Jackson. The sketches, which were made by Mrs. Latimer-Jackson in the course of several visits to Sicily and different parts of the mainland, have not only great artistic merit, but will be useful to students and of considerable interest to many members of the Senate other than professional botanists.

A syndicate has been nominated to consider what changes, if any, are desirable in the regulations relating to the Previous Examination, in the mutual relations of the Previous Examination and the examinations held by the Highest Grade Schools Examination Syndicate and the Local Examinations and Lectures Syndicate, and in the relations of the Previous Examination to examinations held by other bodies. The syndicate has power to confer with the Highest Grade Schools Examination Syndicate, the Local Examinations and Lectures Syndicate, and such other bodies and persons as it may think fit. This is another attempt to bring what is practically the entrance examination of the University into line with modern thought.

OXFORD.—On April 29 Congregation approved a decree authorising the expenditure of 600*l*. in adapting the chemical laboratory at the museum to the immediate needs of the Waynflete professor of chemistry (Prof. W. H. Perkin).

WE learn from *Science* that Princeton University has received three gifts: 20,000*l*. from Mr. and Mrs. Russell W. Moore, of New York City, to endow a professorship of chemistry; 25,000*l*. given anonymously for a professorship not named; and 6000*l*. from Mr. J. D. Cadawallader, of New York City.

THE London County Council will be prepared to award for the session 1913–14 a limited number of free places at the Imperial College of Science and Technology, South Kensington, S.W. The instruction will be of an advanced nature, and therefore only advanced students who are qualified to enter on the fourth year of the course should apply. There is no restriction as to income, but intending candidates must be ordinarily resident within the area of the administrative County of London, and must be students who have been in regular attendance at appropriate courses of instruction for at least two sessions. The free studentships do not entitled the holders to any maintenance grants, but cover all ordinary tuition fees. The free places will be awarded on consideration of the past records of the candidates, the recommendations of their teachers, the course of study which they intend to follow, and generally upon their fitness for advanced study in science as applied to industry. Candidates will not be required to undergo a written examination. Application forms (T. 2/268) may be obtained from the Education Officer, L.C.C. Education Offices, Victoria Embankment, W.C., and must be returned not later than Saturday, May 24.

VACATION courses for foreigners are to be held in Hamburg from July 24 until August 6 next. In all seventy-five lectures and courses have been arranged in connection with the scientific institutions of the State of Hamburg, with the hospitals and the Colonial Institute. The courses will aim at acquainting foreigners with the position of scientific studies in Germany. Scientific problems of the day will be treated by competent specialists in a manner intelligible to educated persons. Some sixty-five professors from German universities and institutes will assist at the courses. For the convenience of foreigners, special practical courses in German have been arranged daily between June 16 and July 26. These courses offer an opportunity of acquiring a practical knowledge of the language. Courses have been arranged also for medical students, including practical work at the Eppendorf Hospital, and a series of lectures on diseases of the heart and lungs. Students will be given opportunities of sight-seeing in Hamburg and its environs. Prospectuses and all information may be obtained gratis on application to "Geschäftsstelle der Akademischen Ferienkurse," Hamburg 20, Martinistrasse 52.

THE organiser for technical education in the Transvaal, Mr. W. J. Horne, has amplified a paper he read before the South African Institution of Engineers at Johannesburg shortly after the establishment of the Johannesburg Trades School, and the result is a volume on the Trades School in the Transvaal, a copy of which has been received. After explaining the need for vocational instruction, he gives a description of the character and scope of the work done in the urban trades schools of the Transvaal, explains the nature and cost of the buildings and equipment in different centres, and reviews what is being done to meet the special needs of rural areas on one hand, and of girls on the other. The volume shows that considerable progress has been made already in the provision of technical education in the Transvaal. The Pretoria Trades Schools and Polytechnic, for example, has accommodation for 200 pupils, and is provided with shops for blacksmiths and farriers, workers in wood, electricians, mechanical engineers, plumbers, wagon-builders, and printers. As Mr. J Percy FitzPatrick, the chairman of the Witwatersrand Council of Education, says, in the introduction he contributes to the volume, "the motto of the Transvaal Trades Schools is 'theory and practice.'" and Mr. Horne insists that the mission of the trades schools must be to unite and harmonise these two essential things. The volume is full of practical suggestions for ensuring this end and of providing means for boys and girls to proceed as far in their study of technology as their capabilities permit.

THE Indian newspapers recently received in this country contain fuller particulars of what is in future to be the Government policy with regard to education in India. The statement circulated in India in February last, we learn from *The Times*, after a recognition of the beneficial effects of the Universities Act of 1904, refers to the new decentralising policy. It is pointed out that there are only five Indian universities for 185 art and professional colleges in British India, besides several affiliated institutions in native states. The day is probably far distant, it is remarked, when India will be able to dispense altogether with the affiliating university. But it is necessary to restrict the area over which the universities have control, securing in the first instance a separate university for each of the leading provinces, so far as possible on a teaching and residential basis. A university of this new type is being founded at Dacca, and the establishment of universities at the provincial capitals of Rangoon, Patna, and Nagpur is contemplated. The Government is also prepared to sanction, under certain conditions, teaching and residential universities at Aligarh and Benares, and elsewhere as occasion may demand. The importance of secondary- and high-school education as the basis of all professional or industrial training in India is emphasised. Private enterprise in this field is so extensive that of 3,852 high and middle English schools only 286 are Government institutions. Unsatisfactory schools have in certain cases gained recognition and eluded the control of inspection. The Government intends to increase largely the grants-in-aid in order that non-State institutions may keep pace with improvements in Government schools; to multiply and improve training colleges; and to found Government schools where a survey of local conditions leads to the conclusion that they are needed. The provision for technical, industrial, and scientific studies is surveyed, and incidentally the statement is made that "the grave disadvantages of sending their children to England to be educated away from home influence at the most impressionable time of life are being realised by Indian parents."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 24.—Sir Archibald Geikie, K.C.B., president, in the chair.—A. G. **Huntsman**: (1) Protostigmata in Ascidians. (2) The origin of the Ascidian mouth.—F. A. **Bainbridge**, S. H. **Collins**, and J. A. **Menzies**: Experiments on the kidneys of the frog. When the frog's kidneys are perfused through the aorta and the renal portal veins with oxygenated normal or hypotonic Ringer's solution the urine formed is hypotonic to the perfusing fluid and is derived entirely from the glomeruli, since the tubules secrete no urine under these conditions. When the tubules are poisoned with corrosive sublimate or (temporarily) with caffein the urine becomes isotonic with the perfusing fluid. On the contrary, if the glomeruli are killed by the arterial perfusion of boiled Ringer's solution, while the tubules still receive an adequate supply of oxygen through the renal portal veins, the urine formed continues to be more dilute than the perfusing fluid.—Cecil **Revis**: (1) The probable value to *Bacillus coli* of "slime". formation in soils. When kept in sterilised soils, particularly if these contain excreta, *B. coli* shows a great tendency to the formation of "slime," a property which is retained for some time when the organism is plated out on ordinary nutrient media. It has been found that soils so inoculated with *B. coli*, together with other soil organisms of a sporogenous type, are able to retain and absorb moisture from the air in a remarkable manner, so that during a period of three years flasks containing these soils and only closed with cotton-wool plugs retained and even increased the original water added to them, whilst controls which did not contain the colon organism rapidly dried up.—C. **Revis**: Variation in *B. coli*. The production of two permanent varieties from one original strain by means of brilliant green. From the experiments it appears (1) that from one single cell there may arise new cells differing in the power of resistance to the same environment and consequently modified by it in a different manner; (2) that the exhibition of physiological activity is not an intrinsic and integral part of the protoplasm, but that such powers may be entirely lost without loss of vitality in the organism itself.

Zoological Society, April 15.—Sir J. R. Bradford, K.C.M.G., F.R.S., vice-president, in the chair.—C. Tate **Regan**: (1) Fishes from Easter Island collected by Prof. F. Fuentes. The collection included examples of ten littoral species, four widely distributed in the tropical Indo-Pacific and six new to science; of the latter two were related to tropical forms and the rest to species described from New South Wales or from Norfolk Island. (2) A revision of the fishes of the genus Kuhlia; twelve species were recognised, including three described as new to science.—R. I. **Pocock**: The affinities of *Canis antarcticus*. It was shown that (1) *C. antarcticus* and *C. latrans* are not closely related, as has been claimed; (2) the affinities of *C. antarcticus* lie with certain South American species of Canidæ; and (3) *C. latrans* must be affiliated with the wolves and large jackals of the northern hemisphere. These conclusions were based mainly upon cranial and dental characters, and the points were illustrated by a series of lantern-slides of the skulls of several species of Canidæ.—Major G. E. H. **Barrett-Hamilton** and M. A. C. **Hinton**: A collection of mammals from the Inner Hebrides. This collection was made during an expedition organised and managed by Mr. W. R. Ogilvie-Grant. Three new forms were discovered: of these one (*Sorex grantii*) is regarded by the authors as an insular development of *S. araneus*, whilst they are inclined to think that the other two (*Evotomys alstoni* and *Microtus agrestis macgillivrai*) are slightly modified survivals from the Pleistocene period. The authors argue that the evidence shows that Islay, and perhaps Jura, were separated from the old Hebridean land-area as well as from the mainland of Scotland earlier than were the other islands. Secondly, they think it likely that the severance of the Hebridean district transpired before that of the Orkneys. Lastly, they consider that the evidence of the mammals supports the suggestion of a former direct land-connection between western Norway and the Hebrides, put forward by Stejneger.—R. **Lydekker**: *Bubalis caama selbornei*, subsp. n., a male hartebeest from the Transvaal.

Royal Meteorological Society, April 16.—Mr. C. J. P. Cave, president, in the chair.—W. H. **Dines**: The vertical distribution of temperature in the atmosphere and the work required to alter it. It seems likely that the vertical distribution of temperature is the result of two opposing tendencies, one the effect of radiation, and the other the forced mixing produced by the general circulation, aided perhaps by the convection caused by the heating of the earth by solar radiation and by the latent heat set free by condensation.—J. E. **Clark** and R. H. **Hooker**: Report on the phenological observations for the year ending November, 1912. The chief factors affecting the field crops were probably the dry warm April and May, followed by the cold wet sunless summer. The spring was perhaps the more important of the two; it affected the corn crops and the hay. All the crops in the United Kingdom were below the average of the preceding ten years, although in Great Britain alone meadow hay was a little better than usual, and hops were also above the mean by fully 23 per cent. The harvest of 1912 must thus be classed as very deficient, and one of the worst experienced for many years.—R. **Corless**, G. **Dobson**, and Dr. C. **Chree**: Meteorological, electrical, and magnetic observations during the solar eclipse of April 17, 1912. The observations discussed were mostly made at the Meteorological Office, South Kensington, and Kew Observatory. The temperature fell nearly 3° during the eclipse, the minimum occurring ten minutes after the maximum phase. At stations in the south of England the loss of recorded sunshine due to the eclipse varied from about twenty to twenty-five minutes.

DUBLIN.

Royal Irish Academy, April 14.—Rev. Dr. Mahaffy, president, in the chair.—H. **Kennedy**: The large ions in the atmosphere. This paper is a continuation of work by Prof. McClelland and the author. The previous work had reference to the air of the city, and it was suspected that flames of various sorts were chiefly responsible for the large ions observed. This view was supported by laboratory experiments showing that ions of the same mobility (1/2000 cm. per sec.) were present in flame gas when allowed to cool. Observations were therefore made at Dalkey, about eight miles from Dublin, at a point on the coast, so that tests could be made of air from over the sea, from country districts, or coming from the city. The average number of large ions per c.c. previously observed in Dublin was 16,000, with a maximum of 54,000. At Dalkey the average was about 1000, and numbers as low as 200 were observed. Only when the air was coming from the city to the place of observation or during fogs were large numbers observed. The paper also contains further data on the relation between the numbers of small and large ions present. The small ions increase in number with the decrease of large ions present.—R. **Southern**: (1) Oligochæta (Clare Island Survey); (2) Gephyrea (Clare Island Survey). (1) Oligochæta. Thirty-four species were recorded. The earthworm fauna of Clare Island was poor, only fourteen species being found. Two new species of the family Enchytræidæ were described, the first, *Enchytraeus cliarensis*, living in weeds on the shore. The second species was of considerable interest, being the first undoubted Oligochæte found below low-water mark. Its remarkable characteristics necessitated the creation of a new genus, and the species was named *Grania maricola*. It was dredged in twenty-four fathoms in Clew Bay. It is closely related to *Enchytraeus monochaetus*, described by Michaelsen from South Georgia, an island in the South Pacific, a species which evidently belongs to the genus Grania. The chief character of the genus is the great reduction in the number of setæ, which are quite absent from the anterior end of the body. (2) Gephyrea. Ten species were recorded from the district. The most interesting were *Aspidosiphon mülleri*, Diesing, and *Phascolosoma intermedium*, a new species dredged in twenty-four fathoms, showing characters intermediate between the genera Phascolosoma and Phascolion.

PARIS.

Academy of Sciences, April 21.—M. F. Guyon in the chair.—A. **Haller**: The formation of tetra-alkyl derivatives of *cyclo*hexanone and β-methyl*cyclo*hexanone and of trialkyl derivatives of menthone.

Using the method with sodium amide, previously described by the author, all of the four hydrogen atoms of the two carbon atoms adjacent to the ketone group can be replaced by methyl or allyl; the introduction of the ethyl group offers difficulties. Full details of the preparation and properties of the compounds obtained by the application of the reaction are given in the paper.—M. de **Forcrand**: Thermochemical study of uranyl nitrate and its hydrates.—M. **Sabatier** was elected a member of the section of non-resident academicians, and M. Jules Boulvin a correspondant for the section of mechanics.—H. **Burkhardt**: A theorem on the gamma function.—Michel **Petrovitch**: The entire transcendentals generalising exponential and trigonometric functions.—A. **Bilimovitch**: Conservative non-holonomial systems with linkages dependent on the time.—Jules **Andrade**: Friction and isochronism of the double spiral. A remarkable property of a group of double spirals suitably chosen. A solution of a problem in chronometry.—Louis **Roy**: The motion of indefinite viscous media.—L. **Décombe**: The electronic theory of gravitation.—Henri **Bénard**: The structure of vortices behind an obstacle. The motion has been studied with the aid of the kinematograph, and a reproduction of a film is given.—C. **Dauzère**: A new species of cellular vortices. A study of the eddies produced in the surface of molten stearic acid.—M. **Deslandres**: Remarks on the preceding communication of M. Dauzère, pointing out the analogy between the phenomena observed by M. Dauzère and those occurring in the atmosphere.—A. **Blondel**: The nitometer, an apparatus for rapidly measuring the brilliance of a luminous surface.—G. **Sizes**: The transversal vibrations of strings.—A. **Portevin**: The elastic limit of alloys. The method used was based on the appearance of the slip bands on the polished surface of the specimen. Six reproductions of microphotographs illustrating the results obtained with different alloys are given.—Georges **Charpy** and André **Cornu**: The transformations of the alloys of iron and silicon. The measurement of the coefficient of expansion of the alloy was utilised as a means of following the transformations instead of the more usual cooling velocity. The critical points obtained by the two methods do not agree.—Daniel **Berthelot** and Henry **Gaudechon**: The dissociation of gaseous compounds by light. The gases ammonia, phosphoretted hydrogen, arseniuretted hydrogen methane, silicon hydride, zinc ethyl, phosgene, sulphur hexafluoride, were submitted to the light from a mercury-vapour lamp. Of these sulphur hexafluoride and methane were the only gases unaffected.—Ch. **Maguin**: The orientation of liquid crystals by sheets of mica.—G. **Lafon**: The use of fat in the animal organism. Fats can be utilised directly, similarly to glucose, particularly in muscular work.—E. **Wertheimer** and G. **Battez**: The mechanism of the salivary secretion produced by the injection of saline water into the vessels. It is shown that the action is almost entirely due to the effects on the nerve system.—André **Mayer** and Georges **Schaeffer**: Lipocytic coefficients and the imbibition of living cells by water. It is proved that there is a numerical relation between the lipocytic coefficient of tissues and their maximum imbibition by water.—Maurice **Arthus**: Experimental researches on the poison of *Buthus quinquestriatus*.—L. C. **Soula**: The relations between anaphylaxy, immunity, and autoproteolysis of the nervous centres. The state of anaphylaxy is accompanied by a marked increase of autoproteolysis of the nerve centres.—Marcel **Belin**: The relations existing between anaphylaxy and immunity. A study of the effect of the injection of oxidising agents on the toxines of tetanus, colibacillus, and vaccine.—Albert **Robin**: The metabolism of the urinary chlorides in cancerous subjects.—Em. **Bourquelot** and Em. **Verdon**: Researches on the biochemical synthesis of β-methylglucoside in a neutral fluid, not taking part in the reaction. This synthesis can be effected by emulsin in aqueous acetone solutions.—E. **Kayser**: Contribution to the study of ropy beer.—Venceslas **Moycho**: Study of the action of ultra-violet light on the ear of the rabbit. The influence of intensity and of intermittent radiations. A continuation of work described in an earlier paper.—Œchsner de **Coninck**: The presence of propionic acid in the secretions of rheumatic subjects. Propionic acid was isolated from the urine.—G. R. **Blanc**: Parasitic typhlitus of the Nandou. The disease appears to be due to a new species of Heterakis, for which the name *H. parisi* is proposed.—Raphael **Dubois**: A micrococcus from the calcareous concretions of tuberculous origin.—J. A. **Samuels**: Cytological studies on the relations existing between the nucleus and the development of crystals in the parenchymatous cells of the perianth of Anthurium.—François **Bochin**: Hydrographical phenomena in the western region of the Paris basin.—Louis **Mengaud**: Contribution to the study of the Wealdian in the province of Santander.—Edmond **Bordage**: The Eocene gulf of Royan.—Jacques **Deprat**: The geology of Tonkin.—Ph. **Négris**: Contribution to the geology of Greece.—F. **Dienert**: The use of absorbent pits. A reply to a communication of M. Dollfus relating to a means of combating floods in the Paris basin.—A. **Boutaric**: A relation between the atmospheric absorption and the polarisation of light diffused by the sky.

BOOKS RECEIVED.

Life and Evolution. By F. W. Headley. New edition. Pp. xx+272+plates. (London: Duckworth and Co.) 5*s*. net.

Geologischer Führer für Exkursionen im Wiener Becken. By Dr. F. X. Schaffer. III. Teil. Pp. x+167+x plates+map. (Berlin: Gebrüder Borntraeger.) 5.80 marks.

New Zealand. Department of Mines. Geological Survey Branch. Bulletin No. 15 (New Series). The Geology of the Waihi-Tairua Sub-division, Hauraki Division. By J. M. Bell and C. Fraser. Pp. vii+192+plates. (Wellington: J. Murray.)

Java. Zoologisch en Biologisch. Afledering I.-V. By Dr. J. C. Koningsberger. Pp. 254. (Batavia: G. Kolff and Co.) 5 francs.

Single-Phase Commutator Motors. By F. Creedy. Pp. x+113. (London: Constable and Co., Ltd.) 7*s*. 6*d*. net.

Rainfall Reservoirs and Water Supply. By Sir A. R. Binnie. Pp. xi+157+xvi plates. (London: Constable and Co., Ltd.) 8*s*. 6*d*. net.

Report on the Danish Oceanographical Expeditions 1908–1910 to the Mediterranean and Adjacent Seas. Vol i., Introduction, Hydrography, Deposits of the Sea-Bottom. Pp. 269+xx plates. (Copenhagen: A. F. Host and Son.)

Earthquakes and other Earth Movements. By Prof. J. Milne. Sixth edition. Pp. xvi+388. (London: Kegan Paul and Co., Ltd.)

Mathematics, Science, and Drawing for the Preliminary Technical Course. By L. J. Castle. Pp. vi+149. (London: G. Routledge and Sons, Ltd.) 1*s*. net.

The Game of Mind. By P. A. Campbell. Pp. iii+80. (New York: Baker and Taylor Co.) 75 cents net.

Practical Physiological Chemistry. By S. W. Cole. Third edition. Pp. xii+230. (Cambridge: W. Heffer and Sons, Ltd.) 7*s*. 6*d*. net.

Earthwork Haul and Overhaul, including Economic Distribution. By J. C. L. Fish. Pp. xiv+165. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 6*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 1.

ROYAL SOCIETY, at 4.—Election of Fellows. At 4.30.—The Capacity for Heat of Metals at Different Temperatures: Prof. E. H. Griffiths and Ezer Griffiths.—The Transition from the Elastic to the Plastic State in Mild Steel: A. Robertson and G. Cook.—Studies of the Processes Operative in Solutions. XXVIII. The Influence of Acids on the Rotatory Power of Cane Sugar, of Glucose and of Fructose: F. P. Worley.—The Attainment of High Potentials by the Use of Radium: H. G. J. Moseley.—The Decrease in Velocity of α Particles in passing through Matter: E. Marsden and Dr. T. S. Taylor.

ROYAL INSTITUTION, at 3.—The Progress of Hittite Studies. III. Cults of Northern Syria: Prof. J. Garstang.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Use of the Electrostatic System for the Measurement of Power: C. C. Paterson, E. H. Rayner, and A. Kinnes.

LINNEAN SOCIETY, at 8.—The Structure of the Wood of East Indian Species of Pinus: Prof. P. Groom and W. Rushton.—Branching Specimens of *Lyginodendron oldhamium*, Will: Dr. Winifred Brenchley.—A Problem in Weismannism: A. C. F. Morgan.—Note on *Sphenopus marsupialis*: Mrs. L. J. Wilsmore.—Polychæta of the Indian Ocean, with some Species from the Cape Verde Islands—The Serpulidæ, with a Classification of the Genera Hydroides and Eupomatus: Miss Helen L. M. Pixell.—Report on the Arachnida of the Seychelles: S. Hirst.—*Gypsina plana*, Carter: Miss Marjorie Lindsay.—Nitidulæ, Heterocidæ: A. Grouvelle.—Pselaphidæ de l'Archipel des Seychelles: A. Raffray.—Anthribidæ of the Seychelles: Dr. K. Jordan.—Hispinæ from the Seychelles: S. Maulik.

FRIDAY, MAY 2.

ROYAL INSTITUTION, at 9.—Blood Parasites: H. G. Plimmer.

GEOLOGISTS' ASSOCIATION, at 8.—The Farnham Gravel Beds in Relation to Palæolithic Man: H. Bury.

SATURDAY, MAY 3.

BRITISH PSYCHOLOGICAL SOCIETY, at 3.30.—Notes on a Case of Morphomaoia: Dr. F. Aveling.—Wonder, Fascination, and Curiosity: Prof. Carveth Read.—A New Tachistoscope: Prof. C. Spearman.

ESSEX FIELD CLUB (at the Essex Museum of Natural History, Stratford), at 6.—Annual Meeting.—*Dalyellia diadema*, a Turbellarian New to Britain: H. Whitehead.—Prehistoric Art: S. Hazzledine Warren.

MONDAY, MAY 5.

SOCIETY OF ENGINEERS, at 7.30.—Tidal Waters as a Source of Power: C. A. Battiscombe.

ROYAL SOCIETY OF ARTS, at 8.—Antiseptics and Disinfectants.: Dr. D. Sommerville.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Frontier Work on the Bolivia-Brazil Boundary: Capt. H. A. Edwards.

ARISTOTELIAN SOCIETY, at 8.—The Notion of the Truth in Bergson's Theory of Knowledge: Miss L. S. Stebbing.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Methods and Apparatus used in Petroleum Testing. II. Viscometry: W. F. Higgins.—(1) The Ore Deposits of Hu-Nan and Hu-Peh; (2) Experiments on the Hydrometallurgical Treatment of Slimes: W. R. Schoeller.—Hydrazinel Nitrate: W. R. Hodgkinson.

TUESDAY, MAY 6.

ROYAL INSTITUTION, at 3.—(1) Recent Physiological Inquiries; (2) Equilibrium and the Sixth Sense: Prof. W. Stirling.

ZOOLOGICAL SOCIETY, at 8.30.—Contributions to the Anatomy and Systematic Arrangement of the Cestoidea. X. Two Species of Tapeworms from *Genetta dongolana*: Dr. F. E. Beddard.—Pacific Salmon: an Attempt to Evolve something of their History from an Examination of their Scales: J. A. Milne.—Note on *Peripatoides woodwardii*, Bouvier: Kathleen Haddon.—Field-observations on the Enemies of Butterflies in Ceylon: J. C. F. Fryer.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Some Recent Work on Post-glacial Geology and Anthropology: Rev. Dr. A. Irving.

VICTORIA INSTITUTE, at 4.40.—The Origin of Life: What do we know of it?: Prof. G. Sims Woodhead.

RÖNTGEN SOCIETY, at 8.15.—Theory and Practice in Ray Therapeutics: Dr. H. Johnson.—Demonstration of a New X-Ray Couch: Dr. Hampson.

WEDNESDAY, MAY 7.

SOCIETY OF PUBLIC ANALYSTS, at 8.—A New Apparatus for Maintaining Constant Temperatures: F. H. Dupré and P. V. Dupré.—The Proportionate Determination of Cocoanut Oil and Palm Kernel Oil in Mixtures: H. R. Burnett and C. Revis.—The Composition of Milk.—H. D. Richmond.—Examination of the Oils from *Manihot ceara* and *Funtumia elastica* and a Comparison of their Properties with those of Linseed and Hevea Oils: Dr. Rideal and L. H. D. Acland.—The Recovery of Iodine from Residues: H. W. Gill.

AERONAUTICAL SOCIETY, at 8.30.—Atmospheric Waves, Eddies and Vortices: Col. H. E. Rawson, C.B., R.E.

ROYAL SOCIETY OF ARTS, at 8.—Life-saving at Sea: A. Welin.

ENTOMOLOGICAL SOCIETY, at 8.—Pupal Coloration in *Papilio polytes*, Linn., and the Larval Habits of the Tineid Moth *Melasina energa*, Meyr.: J. C. F. Fryer.

FARADAY SOCIETY, at 8.—(1) A Re-determination of the Electric Modulus of Aluminium; (2) The Density of Aluminium: Dr. F. J. Brislee.—The Potential due to Liquid Contact. III.: Dr. A. C. Cumming and Elizabeth Gilchrist.—Note on the Electrolytic Determination of Copper in Solutions containing Nitric Acid: Elizabeth Gilchrist and Dr. A. C. Cumming.—New Experiments on Colloids: T. A. Coward. Overvoltage: Prof. J. W. Richards.

GEOLOGICAL SOCIETY, at 8.—The Bathonian Rocks of the Oxford District: M. Odling.—The Petrology of the Kalgoorlie Goldfield (Western Australia): J. A. Thomson.

THURSDAY, MAY 8.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Various Inclinations of the Electrical Axis of the Human Heart: A. D. Waller.—Trypanosome Diseases of Domestic Animals in Nyasaland. III.: *Trypanosoma pecorum*: Surg.-Gen Sir D. Bruce, Major D. Harvey, Major A. E. Hamerton, and Lady Bruce.—The Excystation of *Colpoda cucullis* from its Resting Cysts and the Nature and Properties of the Cyst Membranes: T. Goodey.—The Experimental Hybridisation of Echinoids: C. Shearer, W. de Morgan, and H. M. Fuchs.—The Action of Radium Rays upon the Cells of Jensen's Rat Sarcoma: Dr. S. Russ and Dr. Helen Chambers.

CONCRETE INSTITUTE, at 7.30.—Shear and Problems arising therefrom: H. K. Dyson.

FRIDAY, MAY 9.

ROYAL INSTITUTION, at 9.—Life History of a Water Beetle: F. B. Browne.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, MAY 10.

ROYAL INSTITUTION, at 3.—Humphrey Internal Combustion Pumps: H. A. Humphrey.

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THURSDAY, MAY 8, 1913.

EXPLOSIVES AND PHYSICAL CHEMISTRY.

Explosives: a Synoptic and Critical Treatment of the Literature of the subject as gathered from Various Sources. By Dr. H. Brunswig. Translated and annotated by Dr. Charles E. Munroe and Dr. Alton L. Kibler. Pp. xv + 350. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1912.) Price 12s. 6d. net.

IN this volume Dr. Brunswig attempts to direct the study of explosives from the largely empirical methods of the past into the more definite fields of exact physical chemistry, in which the nature, causes of explosion, and the controlling conditions governing such phenomena naturally fall. For this purpose he has collected the well-known facts (and in many instances those frequently overlooked) and arranged them in a systematic manner.

The earlier sections deal with the general character of explosive reactions, their velocity, pressure, and temperature conditions, the character of the gases evolved, explosion by influence, &c. Judging by most of the literature on the subject, the physico-chemical bearing of these important matters is seldom considered, and Dr. Brunswig's earlier chapters certainly emphasise the necessity which exists for their receiving more consideration, if progress is to be made. As the author points out, "the days of purely empirical progress in the technology of explosives are numbered."

Some comparisons of the energy content of explosives (expressed as the heat of combustion) with ordinary fuels are of interest. While 1 kilogram of liquid petroleum develops 12,000 calories, and average coal about 8000 calories, dynamite (with 25 per cent. kieselguhr) only develops 1300 calories. "Explosives are only technically valuable because they liberate all their energy in a very short space of time." The actual utilisation of this energy, according to the author, by no means compares favourably with that in a high-class engine, such as the Diesel type. The efficiency of such engines is given as 32 per cent. (37 would be a better figure), whilst with most explosives the available energy is calculated to be only 15 to 20 per cent. of the theoretical.

The misleading relative value of explosives of widely different character which may be deduced simply from the heat of combustion, or the product of the gaseous volume and temperature attained (the characteristic product, or potential energy), is evident from the following figures, from tables in the book, when explosive gelatine is taken as 100.

	Comparative value	
	On calories available	On gas volume × temperature
Nitroglycerin	96	97
Guncotton	66	81
Picric acid	49	61
Black powder	41	17
Mercury fulminate	25	11

As the author points out, such misleading figures—which place, for example, mercury fulminate below powder—are due to the omission of the velocity with which the reactions take place. In this connection it should be mentioned that in Noble's classical work with modern smokeless powders, this reaction velocity would not be greatly different for the various explosives he dealt with, and the relative potential energy figures would be unaffected.

The second portion of the book, dealing with the characteristics and manufacture of the principal explosives, will convey little fresh information to those already somewhat familiar with the subject. Dr. Brunswig says that he has "refrained from mentioning other material which has become known to him through personal relation with the technique of explosives," and pleads "the restraining influence of industrial discretion," where contradiction exists between literature and personal knowledge of the facts.

In the list of important propellants, brown prismatic powder and amide powder appear as "great-gun powders," and ordinary black powder as a musket powder. It would be of interest to learn who is still employing them for these purposes. Again, M.D. cordite is classed as a musket powder, but is not included in the big-gun powders.

Erosion is one of the most important questions relating to propellant explosives. The author quotes Sivy's statement that one-third of a kilogram of iron is lost with every shot from an efficient 28 cm. gun. The reader might, however, find difficulty in deciding on the primary cause. In one place it is stated that the percentage of nitroglycerin originally present in the earlier ballistites and cordites was reduced (a change intended solely to reduce erosion) because the explosive contained too much nitrogen. It must not be inferred that the true reason for erosion, the high temperatures resulting from the high proportion of carbon dioxide formed, is overlooked, but this primary

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cause is certainly confused by other ambiguous statements.

Some interesting results of experiments on the liability of metals to erosion may be quoted. They were carried out in an American steel works by firing a heavy charge in a shell, the base of which was formed of the metal under test with a 4 mm. hole bored through. Martin, tungsten, and nickel steels offered about the same resistance to erosion, 20 per cent. nickel steel was much more easily attacked, whilst manganese bronze failed to stand the action of the highly heated gases.

There are several points of interest in relation to the safety of explosives deserving of mention. In view of the extensive investigations and introduction of new methods of testing the liability of mining explosives to cause ignition of methane-air and coal dust-air mixtures, Mallard and le Chatelier's early observation that a methane-air mixture requires ten seconds to ignite when conducted through a porcelain tube at 650–660° C. is worthy of being recalled. The influence of the duration of the flame, on which Bichel has laid great emphasis, is in such circumstances apparent.

With propellant explosives the unexplained effect which gelatinisation of nitrocelluloses has in decreasing the stability of the finished product, as compared with the ungelatinised parent substance, affords opportunity for speculation and research. Here an apparently simple physical change, leading to consolidation, seemingly unconnected with any chemical change, induces a marked increase in the liability to spontaneous chemical decomposition.

The disaster on the French battleship *Iéna* is but an instance of such decomposition leading to grave consequences. The B smokeless powder, which was credited with being the initial cause, consisted of two parts of insoluble nitrocellulose and one part of soluble, gelatinised by an ether–alcohol mixture. The temperature of the magazine where the 10 cm. cartridges were stored which first fired was extraordinarily high with the refrigerating appliances out of action—estimated between 50° and 60° C. The marked acceleration of decomposition of such powders with rise of temperature is one of their striking features.

The book should be generally welcome as an addition to the already extensive literature on explosives, for, in those parts outside the purely practical, the subject is viewed from an unaccustomed point of view, and different aspects from the orthodox are always valuable. Further, the excellent references and index of authors add appreciably to its value. J. S. S. B.

NEW BOOKS ON PHYSIOLOGY.

(1) *Human Physiology.* By Prof. Luigi Luciani. Translated by Frances A. Welby. Edited by Dr. M. Camis. With a preface by Prof. J. N. Langley, F.R.S. In four volumes. Vol. ii.: Internal Secretion—Digestion—Excretion—The Skin. Pp. viii + 558. (London: Macmillan and Co., Ltd., 1913.) Price 18*s*. net.

(2) *Le Problème Physiologique du Sommeil.* By Henri Piéron. Pp. xv + 520. (Paris: Masson et Cie., 1913.) Price 10 francs.

(3) *The Chemical Constitution of the Proteins.* By Dr. R. H. A. Plimmer. Part ii.: Synthesis, &c. Second edition. Pp. xii + 107. (London: Longmans, Green and Co., 1913.) Price 3*s*. 6*d*. net.

(1) THE important character of Prof. Luciani's text-book was well recognised by English readers when the translation of the first volume made its appearance. The second volume, which has just been issued, confirms this impression. The subject-matter is treated, as a rule, in an interesting way, pros and cons on disputed points are discussed intelligently, and the work of past researchers, though in the main chiefly interesting to the historian, is presented with great fulness and lucidity. The book will prove a valuable asset to the professed physiologist and to the advanced student.

For the average or junior student one may say at once that the work is scarcely likely to benefit him much. It assumes he already knows almost as much as its veteran author, and the multiplicity of the authorities quoted and the divergent views expressed by them will only lead him into a quagmire of confusion.

The book will be especially welcome, as it brings to the knowledge of English-speaking workers some idea of the energy and fertility of their Italian colleagues. It is naturally these who are most largely quoted. At the same time the preponderance given to Italian work and thought has its disadvantages, especially as one so often notices the omission of important investigations carried out in other countries. This leads in many cases to a very imperfect presentment of certain problems, and in such instances the subject-matter is consequently not complete or up to date. This is especially noticeable in cases where chemistry has played a part in the elucidation of physiological mysteries. Prof. Luciani is a man of great erudition and boundless industry, but the chemical side of physiology is evidently not his strong point.

His account of the physiology of the suprarenal body could not have been written in a more interesting manner, but beyond the mere mention in a parenthesis of the epoch-making work of Schäfer and Oliver, there is nothing to indicate that it was these workers who founded our knowledge of the physiology of this organ. Adrenaline is referred to as a chemical substance of known composition, but there is no description of its constitution, nor of the success which has attended the efforts which have been made to synthesise it.

The account given of the pituitary is similarly marred by the entire omission of Herring's and Howell's researches, which have thrown so much light on its development, structure, and functions.

Nussbaum's work on the kidney is mentioned and dismissed with a shrug because Adami failed to confirm some of his statements. We are not told that Adami subsequently withdrew most of his criticisms, nor of the important recent development of the Nussbaum method in this country, which has shown that this particular means of investigation has proved to be a sheet-anchor in our conception of the mechanism of the renal organs.

So also in the discussion on the absorption of proteins the author's knowledge seems to have stopped short at an epoch when it was believed that proteose and peptones were absorbed as such, and we have many pages devoted to an antiquated description of how these are re-synthesised in the intestinal wall into the blood-proteins. The work of Fischer, Abderhalden, and a host of American workers is passed by without a reference.

Such examples might be multiplied almost to weariness. It would therefore be advisable that if advanced students take this book as their guide it would be well for them not to rely exclusively upon it. They will derive both pleasure and profit from its study, but if they desire the latest and most accurate account of modern views they should supplement it with reading other books which deal rather with the present than with the past.

(2) Dr. Piéron's book on sleep is of quite a different character, for it only treats of one small corner of physiology, and yet he has contrived to write a volume on this subject almost equal in length to the one we have just considered. It, however, resembles Prof. Luciani's in its wealth of references. Some sixty pages are devoted to bibliography alone. This indicates how much has been written, but it also shows how little we really know.. If physiologists had satisfactorily solved the intimate meaning of sleep, there would be no need of so much discussion and printer's ink, and the subject might have been discussed in as many lines as there are pages devoted to it. It is only fair to say, however, that the book is a singularly interesting one, and the subject is discussed with that admirable clearness which distinguishes the writings of most French authors. Of all the numerous theories advanced, some chemical, some circulatory, some histological, some psychological, and so forth, the author most inclines to the so-called inhibition hypothesis. The book is entitled a physiological problem, but many pathological or quasi-pathological states are included; thus we have chapters devoted to coma, unconsciousness produced by drugs and other means, fatigue, hypnosis, and others. It will therefore appeal to the students of pathology and medicine as well as to those who make physiology their life-work.

(3) The third book on our list, that by Dr. Plimmer on protein synthesis, is the second edition of a work which has already been favourably noticed in these columns. The mere necessity of a second edition of such a highly technical work is no mean testimony to its excellence. So rapid have been the recent advances in knowledge on this question that the book is very largely a new one, and it is thoroughly up to date. To peruse the original memoirs on which the book is founded is a task which would deter many authors, and certainly the majority of readers. The useful summary Dr. Plimmer has given will relieve the latter class from undertaking such a labour. It would be damning the book with faint praise to say that it is interesting; it is far too technical and packed with facts and formulæ to make it light reading, but to those who want to know the recent developments in one of the most important of the problems of the day to which either chemists or biologists can apply themselves, the book will prove a veritable godsend. W. D. H.

THE GAS TURBINE AND OTHER ENGINES.

(1) *The Gas Turbine.* By H. Holzwarth. Translated by A. P. Chalkley. Pp. viii+140. (London: C. Griffin and Co., Ltd., 1912.) Price 7*s.* 6*d.* net.

(2) *A Primer of the Internal Combustion Engine.* By H. E. Wimperis. Pp. xiii+143. (London: Constable and Co., Ltd., 1912.) Price 2*s.* 6*d.* net.

(3) *Vapours for Heat Engines.* Including Considerations Relating to the Use of Fluids other than Steam for Power Generation. By Prof. W. D. Ennis. Pp. v+78. (London: Constable and Co., Ltd., 1912.) Price 6*s.* net.

(1) ENGINEERS interested in this very difficult problem are much indebted to Mr. Holzwarth for his ingenuity, to Mr. Junghaus for his support, and to both for their liberality

in making public the results of their labours in this direction up to the present. Though the book is but a small volume of 140 pages, the matter is greatly condensed, and will demand close attention for its full significance to be appreciated.

The essential unit of the Holzwarth gas turbine consists of a combustion chamber into which gas, or hydrocarbon vapour, and air are delivered at a small pressure by a suitable pump through mechanically operated inlet valves; ignition is by high-tension magneto, and the resulting high temperature and pressure combustion products then discharge through a spring-controlled flap valve, *via* a nozzle, to the rotor vanes; having passed the rotor, the gases enter an exhaust pipe, wherein a partial vacuum is constantly maintained by an exhauster. Very shortly after ignition the flap valve is slowly closed by mechanical means, time being permitted for a gust of scavenging air to pass through, thus cleansing and filling the combustion chamber in readiness for the next working charge of vapour, and cooling the nozzle and rotor vanes. The action is thus intermittent, and the design involves three valves in each unit, together with charging and exhausting pumps. In the actual turbine several such units are arranged symmetrically around a turbine wheel or rotor, the continuous speed of which is preserved by the successive impulses thereby imparted to its vanes. As fuels, petrol, kerosene, gas oils, benzol, and even tar oil may be satisfactorily employed.

The book is divided into four sections, in the first of which a theory of the gas turbine is exhibited mathematically by aid of analysis and of entropy diagrams; much of this part is of the nature of a summary of formulæ and results, and cannot be fully appreciated without much reference to other works; moreover, partly on account of difficulties of analysis, but largely from imperfection of the physical data, some of the conclusions reached are of a very conjectural character, and may require substantial qualification after a more extended practical experience. The author considers in detail the several operations of charging, compression, ignition, combustion, expansion, and scavenging; he concludes that the intermittent action used, with the lowest possible temperature of charge prior to ignition, and the largest possible nozzle opening, is essential to economy, and is conveniently realisable in actual design. Data relative to compression are still wanting, and the investigation given proceeds largely upon assumptions suggested by experience and general knowledge; in the Holzwarth combustion unit it is not practicable to compress to any extent before ignition, but the author is persuaded that satisfactory turbine efficiencies are attainable at much lower compressions than are usual in reciprocating engines.

An interesting section of the work is that dealing with the utilisation of the exhaust heat; by aid of a "regenerator," sufficient heat is said to be recoverable to work the charging and exhausting apparatus.

The construction and details of the actual turbine are described, and the text is illustrated by many well-drawn and clearly executed figures. The gas turbine is as yet in its infancy, and it would be unfair at the present time to compare it with the modern reciprocating high-efficiency engine; in the last section of the book test results are given, together with copious diagrams and tables. Progress is continuing, and further experimentation is needed, and will be carried out by the able author and his business colleague.

The translator is to be congratulated on his work; the text is in such good and clear English as to betray no suggestion of its German origin. The book is well printed and illustrated, and from all points of view is a welcome and valuable addition to the literature of the problem.

(2) This is an excellent elementary text-book on the internal combustion engine, with special reference to the small petrol engine, and forms a suitable introduction to the larger work by the author on the same subject; though succinctly presented, the matter is never obscure. A brief historical notice is succeeded by an account of the leading facts of the theory of heat and the fundamental formulæ of the ordinary theory of perfect gases. The desirable feature appears of a limited use of easy differentials, the several steps of the reasoning being given in full so that the student should experience no difficulty in following the argument to its conclusion; that nebulous quality, entropy, is also dealt with intelligibly, and a useful account is given of indicators and indicator diagrams. The difficult subject of explosion pressures is treated in the light of the results obtained by the Gaseous Explosions Committee, the variability of specific heat with temperature being suitably emphasised. This is followed by descriptions and large sectional views of actual typical engines, including the Diesel and semi-Diesel types, together with illustrations and an account of uncooled and cooled pistons and valves, and a short note on Aëro engines.

Chapter vi. treats more fully of fuels, both liquid and gaseous, including alcohol and benzol, and the principle of the gas producer; next some engine details, notably ignition and carburation are shortly described; finally, a chapter is devoted to the testing of engines, and reference is made to the author's accelerometer; we should like to have found a more detailed account of this very ingenious and useful instrument. Examples are introduced in various portions of the work for the student's exercise on points of theory, and answers to many of these are given at the end of the work, which concludes with a useful index. Both in matter and style the book is much better than many of the small elementary treatises that have already appeared, while the printing and illustrations leave nothing to be desired. Altogether this forms an attractive and useful little work which will prove of real assistance to the student in the earlier portions of his course.

(3) In this tract of 78 pages are conveniently collected data as to the physical properties of special interest to the engineer of several liquid substances, including alcohol, chloroform, carbon tetrachloride, ether, ammonia, sulphur dioxide, acetone, and carbon disulphide, together with steam tables. The collection should prove useful for purposes of reference; the author uses British thermal units and Fahrenheit degrees of temperature, and his figures will thus be immediately available to the great majority of British engineers to whom it is still difficult to think in metric and centigrade units, notwithstanding the theoretical advantages claimed for the metric system.

In appendix i. the formula for chloroform ($CHCl_3$) is incorrectly given as C_2HO_3, and "carbon chloride" is used for carbon *tetra*-chloride; as there are several carbon chlorides it seems desirable to distinguish clearly which is referred to.

The work is well got up, and contains numerous tables and diagrams relative to the substances dealt with, together with a discussion of the limits of efficiency attainable theoretically with the several liquid fuels considered.

OUR BOOKSHELF.

Percentage Compass for Navigators, Surveyors, and Travellers. By J. C. Fergusson. (London: Longmans, Green and Co., n.d.) Price, unmounted, 2*s*. 6*d*. net; mounted on linen, 3*s*. 6*d*. net.

Mr. Fergusson has apparently just discovered what everyone knew before, viz., that at the angle of 45° the natural sine is equal to the natural cosine, or the one is 100 per cent. of the other, and, being obsessed with the idea that the one great object in life is to work out percentages, he has taken the trouble to find the values of the natural cosines when the natural sine has any percentage from 1 to 100 to those natural cosines. He then divides the compass circle into octants, and each octant into 100 unequal parts, or percentages, and states that by the use of these percentages Traverse tables are no longer required.

What Mr. Fergusson has really done is to make a new Traverse table where the natural cosine, arranged in percentages in a circle outside the compass, has to be multiplied by the percentage course steered to obtain the natural sine.

At present both natural cosine (diff. of latitude) and natural sine (departure) can be obtained from the ordinary Traverse tables for every degree of the compass and for any radius between 1 and 300.

Not only does Mr. Fergusson give a roundabout way of obtaining a result which can be readily extracted from the Traverse tables, but he also seems to think that the natural cosines and sines on a circle, the zero of which points to the magnetic north, will give the difference of latitude and departure by utilising the percentages of the octants on a compass card marked by his method. These, it is scarcely necessary to point out, can only be ascertained when the zero of the circle points to the true north, or each course steered has been corrected for the magnetic variation and any local disturbance caused by a vessel's magnetism.

An Essay on Hasheesh. Including Observations and Experiments. By Victor Robinson. Pp. 83. (New York: "Medical Review of Reviews," 1912.) Price 50 cents.

It is difficult to regard this booklet as a serious contribution to medical literature. It consists of about four score small, narrow pages, about half of which are occupied by an account of the hallucinations and rhapsodies experienced by the author when under the influence of the drug *Cannabis sativa*. What the precise value of these observations is it is impossible to discover. It is no more practicable to subject them to rational or systematic analysis than to attempt to find reason or method in the incoherent ravings of delirium. The particular manifestations induced by Indian hemp must, of course, largely depend upon idiosyncrasy, temperament, antecedent and accidental conditions, and a host of predetermining and fortuitous causes, and must therefore vary from individual to individual and differ, too, in different circumstances even in the same individual.

The only valuable section of the book is the short digest of the little that is known from prior work concerning the therapeutics and chemistry of hasheesh.

Life and Evolution. By F. W. Headley. Pp. xx+272. Second edition. (London: Duckworth and Co., 1913.) Price 5*s*. net.

The present does not differ greatly from the first edition, which was reviewed in the issue of Nature for March 7, 1907 (vol. lxxv., p. 434). Mr. Headley has re-written a few pages, corrected occasional inaccuracies, and replaced several unsatisfactory illustrations by better. He has also, in the light of new facts which have become available since the book appeared first, modified some of his views.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Proposed Tropical University.

THE proposal to create a tropical university which has been put forward in the columns of NATURE and elsewhere is one which requires careful scrutiny and calls for a clear appreciation of the real issues involved.

It seems at least open to question whether the advocates of the scheme really contemplate a new university, or whether they are not rather thinking of a college or institute of university rank, the work of which should be somewhat intimately associated with the promotion of the material prosperity of the great agricultural interests that are growing up in the tropics. Such a college, in addition to the function of inducting men into the various branches of tropical agriculture, should serve, if properly staffed and organised, as a centre for the dissemination of current information on matters pertaining to the industrial needs of the community, in so far as agricultural problems are concerned. For this purpose it is essential that facilities for field and other experiments should be fully provided, and if the site were suitably chosen the college would prove an invaluable training ground, not only for the population resident within its immediate geographical area, but for others also, and especially perhaps for Europeans, about to engage in agriculture in any part of the tropics. Various places have been suggested as possible sites, and there is much to be said in favour of the West Indian proposal. Easy access from Europe, as well as the variety of soil, climate, vegetable products, &c., are all points in its favour, whilst the fact that no British institution of the kind desired exists in that region is a defect which would thus be repaired. Furthermore, the possibility of securing a considerable range of advantages within a relatively small geographical area is of itself a distinct gain, for it could be more economically worked than a similar institute in a large continental area, where things are on a larger scale, quite apart from limitations imposed by a continental climate, which cannot be ignored.

Accepting for the moment the desirability of founding a college of the kind indicated, the danger that lurks in the scheme would almost certainly be found, in practice, to consist in a desire to see immediate results which would be convertible into a cash value by the planters. In order to ensure success, it is absolutely essential that a wise and far-sighted policy should guide the destiny of the institute. Agricultural problems, and especially tropical problems, are seldom simple, and while immediate practical objects need not, and should not, be lost sight of, the college would fail to justify its creation if it were to exist for these purposes alone. It must, while not neglecting the practical training of students in tropical agriculture, also include within itself, as a vitally essential part, a body of first-rate scientific investigators and teachers, who will be able to seize upon problems and work them out. There must be no attempt to limit their work to the economic questions of the moment, for in cramping the spirit of investigation lies the way of throttling material progress.

Such a staff would, of course, cost money, and often the return might seem to be slow in coming, but it is impossible to over-estimate its importance. Indeed, unless a proper staff can be provided, the scheme is not worth pursuing, for the most that could then be hoped for would be a mere technical institute —a sort of edition *in parvo* of current planting practice, veneered over by a fallacious appearance of scientific equipment.

Now an institute such as is here foreshadowed would greatly gain by connection with leading institutions in this country. Science is growing apace, and particularly those branches of it which especially touch on agriculture. And, however able the staff, it could not hope to escape from the disadvantages inherent in a separation from the main clearing-houses of scientific thought. Some sort of association, then, with home institutions, such as the University of Cambridge and the Imperial College of Science and Technology, for example, could not fail to be of advantage to all concerned. An association of this kind ought to be a real and not a merely nominal one, for only in this sense could it serve any useful purpose and provide for an interchange of knowledge and for the stimulation of ideas. Arrangements might perhaps be made for enabling suitable students of the college to visit this country and be received for a time in the home institutions, and *vice versâ*.

Such a college, conceived and maintained on generous lines, would develop into a valuable asset to the Empire, and would exert a powerful influence in furthering the interests and objects of tropical agriculture within it.

But the question of an insular tropical *university* is a very different one. There are perhaps already more than enough universities, and it is difficult to see how it would be possible to justify the foundation of another in the manner that has been suggested, —quite apart from the very considerable outlay that would be necessarily involved.

Moreover, a centre of real university learning, and still less of culture, can scarcely be created by the stroke of an administrative pen, and it would, in any event, be compelled to seek its justification in the existence of a population large enough and able in other respects to utilise the advantages the university ought to be in a position to confer. And it seems open to inquire whether a mere fraction of the financial resources which would be needed for the more ambitious project might not amply suffice to enable everyone of marked ability to enter an existing university elsewhere, if he (or she) were otherwise unable to do so. There would be many disadvantages inseparable from a small insular university, and it is scarcely necessary to dwell on them here. For the present it may suffice to remark that a second-rate university is not worth its upkeep, whilst a properly staffed and equipped one would demand very considerable funds, and not only so, but other claims, difficult to meet, would also have to be satisfied.

The further one reflects on the matter the weaker does the case for the establishment of the university, and the stronger the claims for the foundation of an agricultural college, appear. Almost all the arguments which can be urged against the first proposition can be used in support of the latter. But it may be that after all a substantial agreement already prevails amongst the majority of those who are advocating the scheme, and that an agricultural college of university rank is really what is desired.

J. B. F.

The Mountains and their Roots.

IN NATURE of February 27, p. 703, you honoured me with a review of my recent paper on the origin of the Himalaya Mountains. During thirty years of residence in these mountains I have continually been confronted by the geodetic problems which they present. The highest geological authorities express doubts as to how mountains have been upraised, and geological theorists differ widely.

In my recent paper I suggested, with diffidence, the hypothesis that the long belt of Indus-Ganges alluvial plains was concealing a deep crack in the subcrustal shell of the solid earth, and that the Himalaya mountains had been crumpled up by the opening of this crack in the solid globe.

When a large mass of heated rock, or ore, or glass is cooling, its surface is apt to crack; we never see the core of any such mass shrink away from the outer shell and leave the outer shell too large and unsupported, as is often assumed to be happening in the case of the earth.

Are geologists quite sure that the earth's outer shell has not been cracking, and that the cracks are not hidden from our sight by silt? Would not the cracking of a solid globe provide a sufficient mechanical force to elevate mountains?

The earth's rotation is slowing down; the equatorial protuberance of rock is constantly straining to move polewards.

Throughout the whole length of the Indus-Ganges belt of plains earthquakes are frequently occurring, and what can be causing these earthquakes, if not the splitting asunder of the solid globe beneath?

At both extremities of the Indus-Ganges belt deep narrow submarine cañons exist extending far out to sea; they are known to sailors as "swatches." What are these swatches, if not the surface indications of a subcrustal crack?

In the review in NATURE my hypothesis is dismissed without any specific objection to it being raised. I am not wedded to it, and I should welcome its dismissal, if I thereby learnt its errors. But I am disappointed to see it rejected merely because my critic has himself accepted the "floating crust" hypothesis.

The reviewer has accepted as true the hypothesis of the Rev. Osmond Fisher. According to this hypothesis the solid crust of the earth is of limited thickness and floats upon a liquid magma of greater density. This assumption of a liquid substratum appears to me to be opposed to the views of the great majority of geological writers. So far as I am able to judge, the weight of the evidence seems largely in favour of a solid globe.

Furthermore, Mr. Fisher has to assume that as the central core of the earth cools down, the outer crust is left unsupported owing to the core's contraction ("Geology of India," R. D. Oldham, p. 471). This assumption of a cooling core contracting away from its shell seems to me to be more difficult to justify than the assumption of a cooling shell becoming too small for its core.

But let me descend from these great assumptions to actual geodetic figures.

Mr. Fisher assumes that the crust floats in the dense liquid, just as ice floats in water. Each mountain rising from the upper surface of the crust has a corresponding protuberance extending downwards from the lower side of the crust. The buoyancy of a protuberance suffices to support the weight of the corresponding mountain above it.

If h=height of a mountain, and if d=depth to which its protuberant root extends downwards into the liquid, then, according to Fisher, $d=9{\cdot}6\times h$.

Now let me apply this hypothesis to the mountains of India. All these mountains are assumed to be buoyed by subcrustal protuberances of lower density than the magma, but the protuberances extend downwards to different depths, which are proportional to the several mountain heights.

Mountain	Height of mountain above crust = h Miles	Depth of protuberance below crust = d. Miles
Tibet plateau	3	29
Himalayan range	4	38
Vindhyas	0·6	5

Let us suppose a plumb-line to be suspended near the foot of a mountain, and let us suppose that the mass of this mountain is compensated by a deficiency of density underlying it below the crust. If that deficiency of density be wholly concentrated near sea-level, it will entirely compensate the attraction of the mountain mass, and the plumb-line will hang vertically. But if that deficiency of density be distributed to a great vertical depth, it will not compensate the mountain's attraction, first, because of its greater distance in depth from the plumb-line, and secondly, because its resultant action is more inclined to the horizontal.

If a mountain (Himalayan) is four miles high, and if its protuberance extends downwards to a depth of thirty-eight miles, the geodetic observer would report:—"There is distinct evidence of compensation, but the compensation is by no means complete."

If, however, a mountain (Vindhyan) is 0·6 mile high, its compensation would take place within five miles of the crust, and the observer would report:—"The compensation is here more complete than in the case of the higher mountain."

Similarly a pendulum observer at a station (Himalayan) two miles high will (according to the Fisher hypothesis) not find the same degree of compensation as he will at a station (Vindhyan) half a mile high. The underlying deficiency of density will in each case have a retarding effect on the pendulum, but at the Himalayan station the deficiency reaches downwards nineteen miles into the liquid, whilst at the Vindhyan station the deficiency only extends five miles downwards.

According, then, to the "floating-crust" hypothesis our plumb-line and pendulum observers should find the attraction of small mountains more completely compensated than the attraction of high mountains. But what are the results of actual observations? Both the pendulum and plumb-line observers find the attraction of the Himalayas to be largely compensated, whilst the Vindhyan mountains are not compensated at all. Actual results of observation are in direct opposition to the "floating-crust" hypothesis.

Mr. Hayford has stated that the "floating-crust" hypothesis is not true for the United States of America ("Figure of the Earth and Isostasy," p. 164), and in my opinion the evidence is sufficient to show that this hypothesis is not true for India.

S. G. BURRARD.

Surveyor-General's Office, Dehra Dun, March 29.

As an officer of the Survey of India, employed for many years in determining deflections of the plumb-line and variations in the intensity of gravity, I was interested to find in the article which appeared under this heading in NATURE (No. 2261, vol. xc., February (27) reference to the hypothesis suggested in 1904 by the Rev. O. Fisher as to the nature of mountain compensation, and the statement that this hypothesis goes far to explain the deflections of the plumb-line observed at the foot of the Himalayas and in the Gangetic plain. The article states that, according to Mr. Fisher's hypothesis, "the crust is of uniform density, the isostatic compensation being obtained by a variation in thickness," and that, on this hypothesis, Mr. Fisher "finds that the attraction of the visible range combined with the negative attraction of the downward protuberance should give a northerly deflection of about 24″ at the foot of the hills, of about 2″ at sixty miles away, and a southerly deflection of about 2″ at the farther edge of the plains. These results appear to be in very fair accord with the observations. . . ."

This statement is liable to convey a wrong impression. We are given to understand that the effects of the visible mountain mass and the downward protuberance are sufficient to explain the observed phenomena. The facts stated below will show how far this is correct. In addition, the article referred to makes no mention of an important feature of the Rev. O. Fisher's hypothesis. We are not told that part of the deficiency of mass which compensates the visible mountain range is supposed to be, not under the range, but under the plains. Mr. Fisher's hypothesis is not one of simple isostatic compensation, but involves the horizontal displacement of part of the compensating deficiency.

Mr. Fisher's investigations were published in *The Phil Mag.* of 1904, in an article which your reviewer suggests has been overlooked by Col. Burrard in his paper, "The Origin of the Himalaya Mountains: a Consideration of the Geodetic Evidence." As regards the overlooking of Fisher's investigation, it will be sufficient to point out that it was included, at Col. Burrard's own request, as an appendix to Professional Volume xviii., "Astronomical Latitudes and Deflections of the Plumb Line," published by the Survey of India in 1906. Also on p. 5 of Col. Burrard's paper under reference, we find the hypothesis of horizontal displacement of compensation discussed and rejected.

Before discussing Fisher's investigation, let me state the facts that require explanation. At the eastern end of the Himalayas are found northerly deflections of 46″, at a point about five miles north of the foot of the slope, and of 1″ at a meridional distance of twenty miles south of the slope. The variation of deflection in the twenty-five miles is 45″. In the central Himalayan region we find 38″ north at a few miles north of the foot of the slope and 5″ south at a meridional distance to the south of 112 miles, the variation here being 43″ in 112 miles. In the western Himalayas, in the meridian of Dehra Dun, deflections occur of 31″ north at the foot of the hills, and of 1″ north at a meridional distance of fifty-six miles. Here the deflections change by 30″ in fifty-six miles.

Thus, in a strip of country from thirty to 100 miles wide, lying immediately at the foot of the Himalayan slope, there is found a very rapid variation in the deflection of the plumb-line in the meridian. But while the variation is large, the average deflection over this tract is small, rather less than 20″ north. The observed variation of deflection is greater than that due to the visible Himalayan mass considered entirely uncompensated, and it might seem that we must admit this complete want of compensation of the hills in combination with a deficiency under the plains. Here, however, we are opposed by the evidence of the deflections themselves. Though we find that the observed variations of deflection are greater than if compensation did not exist, the observed deflections themselves are much smaller.

Now, Mr. Fisher, in his paper of 1904, investigated the deflections at three points on the meridian of Kalianpur. One of these lies at the foot of the Himalayan slope, and Mr. Fisher correctly takes Dehra Dun as representing this point. A second point, sixty miles from the slope, is represented by Kaliana, while the third point is 293 miles from the foot of the slope. This point is considered to represent Kalianpur. Kalianpur, however, is about 420 miles, measured on the meridian, south of Dehra Dun. The point 293 miles from the foot of the slope corresponds more nearly with a point between Usira and Kesri.

The observed phenomena which Mr. Fisher had before him were a change of deflection, amounting to 30″, in the sixty miles between Dehra Dun and Kaliana, and an average deflection in this interval of 16″; a change of 43″ between Dehra Dun and Kesri, with an average deflection of 16″.

Considering Fisher's investigation first from the mathematical point of view, we find that the theoretical plumb-line deflections are calculated for three points only, while his formulæ involve several unknowns, thickness of crust, crustal density, ratio of crustal to subcrustal density, the degree of compensation which, taken into consideration with the ratio of densities, determines the depth of the mountain root, the deficiency of mass underlying the plains and the area over which this is distributed. Obviously more than one set of suitably adjusted values of these unknowns will bring the formulæ into accord with the observed facts. The agreement, if such agreement did exist, of Fisher's calculated quantities with the observed deflections would be interesting, but it would not prove the correctness of his hypothesis.

Mr. Fisher calculated the theoretical deflections on two hypotheses, neglecting the effects of sphericity. In the first the visible mountain range is compensated by a deficiency of mass vertically below it. The results of this calculation are exhibited on p. 17 of *The Phil. Mag.* for January, 1904. The theoretical change of deflection over the sixty-mile interval is found to be 15·5″ in a plane at right angles to the range, or about 12″ in the meridian, with an average deflection of about 6·5″ in the meridian. These calculated quantities of 12″ and 6·5″ correspond to the observed 30″ and 16″. In calculating the effect at 293 miles from the slope, evidently an error has crept into Mr. Fisher's computations. The residual deflection is stated to be away from the mountain range. This is an impossibility where sphericity is neglected. The positive attraction of the visible mass and the negative attraction of the compensating root only become equal at an infinite distance from the mass. In a later paper, dated April, 1904, other figures are given for the deflection at the south of the plains, making the theoretical difference between deflections at the foot of the slope and at the south edge of the plains about 17″, with an average deflection of 10″ against the observed 43″ and 16″.

It is evident that "the attraction of the visible range, combined with the negative attraction of the downward protuberance," fails to give theoretical effects in accord with the observations.

Mr. Fisher then modified his first hypothesis, and it is this modification that has been lost sight of by the reviewer of Col. Burrard's paper. Mr. Fisher now supposes the mountain mass not supported solely by the root immediately beneath it, but partly by the effect of the crust below the Siwalik rock of the plains being depressed by 15,000 ft. into the substratum. A third factor is thus brought into operation, namely a deficiency of mass underlying the plains. It is true it may be claimed that the deficiency is considered as part of the isostatic compensation of the visible Himalayan mass, and that Fisher's system does not introduce a third entity, but merely implies an irregular distribution of compensating masses. The whole deficiency equivalent to the surface excess, instead of lying directly below the latter, is, in part, displaced horizontally to below the plains. But the elimination of part of the deficiency below the visible range has the effect of altering the variation between deflections at the foot of the slope and at the south edge of the plain by only 2″, whereas the differential effect of this deficiency of mass, when transferred to the subcrust under the plains, is 8″. The significant fact is not so much the reduction of deficiency below the mountain range as the location of a deficiency under the plains between the foot of the slope and the southern station of observation. In Fisher's hypothesis this is the important feature which brings about a more rapid variation of deflections than follows from the assumption of simple compensation.

The results of the calculation upon the second hypothesis give 20″ as the variation of deflection between Dehra Dun and Kaliana, with an average deflection of 12″, against the observed 30″ and 16″. The calculated variation and average deflection for the interval between the foot of the hills and the southern edge of the plains are, respectively, 24″ and 10″, the observed values being 43″ and 16″. The differences between Fisher's quantities, based on the second hypothesis, and those observed, approach, on an average, 35 per cent. of the observed values.

Both hypotheses, that of simple and that of general compensation, fail to give results in accord with observation, when Fisher's numerical values are used. In his second hypothesis his assumption of a three-mile depression of the crust is inadequate. As pointed out by Col. Burrard in his paper, to explain Himalayan deflections by a hidden synclinal, we must assume the latter to be seventy to eighty miles wide and six miles deep under Siliguri, seven miles south of the foot of the slope, and two miles deep under Jaljaiguri, thirteen miles south of Siliguri, the rock composing the synclinal basin to have a density of 2·7, and the sediment filling the synclinal to have a density of 1·9. As Col. Burrard says, it is doubtful whether the density of sediment, when under a pressure of a vertical column six miles high, would remain as small as 1·9; any increase in its value will require the depth of the supposed synclinal to be increased.

In connection with Fisher's investigation, there is an interesting point. Putting aside his computed figures, we see that both he and Burrard agree in considering that the observed facts cannot be explained by only the visible Himalayan mass and its vertically underlying root. Both investigators are forced to conclude the existence of a third factor, a source of negative attraction under the plains at the foot of the hills. Fisher prefers to adopt the idea of deficiency extending under a relatively wide belt of the crust due to the depression of the latter into the liquid substratum, the outer surface of this depressed tract being brought up to sea-level by the deposition of the Siwalik beds and alluvium. This hypothesis leads to the assumption of very doubtful values of some of the unknown quantities, as has been shown above. Burrard's hypothesis differs from Fisher's in that he would localise the deficiency in a rift in the crust subsequently filled in by deposits.

H. M. COWIE.

Dehra Dun, U.P., India, April 3.

SURELY Col. Burrard and Major Cowie have misread the review; it did not dismiss Col. Burrard's speculations, but pointed out that he had himself dismissed, with what appeared to be inadequate examination, an hypothesis which seemed fully capable of explaining the facts. The sentence which has elicited their letters was intended to refer solely to the memoir under review, and had no application to other publications by the same author. The memoir did not, in fact, contain any detailed investigation of an hypothesis which, if tested numerically and in its completeness, appears to be at least as capable of affording an explanation of the facts as that propounded by Col. Burrard. The reviewer may point out that the limited amount of space at his disposal compelled the omission of reference to many points of which he was well aware, and had fully considered, but in view of the publication of these letters he may be permitted to amplify the argument of the paragraph in the review which has called them forth.

Mr. Fisher's investigation assumes an isostasy by flotation, and, what is an almost inevitable consequence, that the flotation is not confined to the area of the range, but that, as an iceberg has generally an under-water extension helping to support the visible mass, so the lighter "crust" under the plains is borne down into the denser "substratum" or "subcrust" by the weight of the mountain range. This interpretation is in accord with the evidence of the pendulum, which shows that the defect of gravity under the mountains is continued under the plain, and only gradually decreases with increasing distance from the range; it is also in accord with conclusions drawn by the Geological Survey long before the observations of variations in the force of gravity and of deflection of the plumb-line in the neighbourhood of the foot of the hills were published, and the constants used by Mr. Fisher, so far as they are special to the Himalayas, were taken from these reports.

According to the hypothesis, a station near the edge of the hills, such as Kurseong, would be affected (1) by the positive attraction of the visible masses; (2) the negative attraction of the "root" or downward thickening of the "crust" into the "substratum"; (3) by the negative attraction of the submerged portion of the "crust" under the plains, replacing denser "substratum"; and (4)—though Mr. Fisher did not separately consider this—by the negative attraction of the alluvial deposit of the plain, the mean density of which is less than that of average rock. Of these (1) is the same whatever hypothesis of isostasy is adopted; (2), it appears from Mr. Hayford's investigation of the effect of an isostasy produced by compensation limited to a ten-mile stratum, between twenty-five and thirty-five miles depth from the surface, would somewhat increase the deflection at a station situated on the edge of the hills (*e.g.* Kurseong), and make but little alteration at a station twenty or thirty miles out in the plain (*e.g.* Jalpaiguri); (3) and (4) would both produce their maximum effect at a station situated like Kurseong, and have comparatively little influence at one situated like Jalpaiguri. Here we have three separate corrections, all working in the same direction, and all attaining their maximum at the same station, and it is not inconceivable that together they might afford an explanation of the peculiarities noticed by Col. Burrard.

It is obviously useless, at the present stage of our knowledge, to enter into detailed calculations of an imaginary range, but some approximate calculations made by the reviewer indicate that the increase in the difference of deflection as between Kurseong and Jalpaiguri due to (2) would be of the order of 4″, to (3) of the order of 8″, and to (4) of not less than 9″, or a total increase in the calculated difference of deflections amounting to more than 21″, as compared with Col. Burrard's unexplained anomaly of 30″. These figures have no value, except as indicating that there is another hypothesis, besides that of the "rift," which would account for a change in the amount of deflection near the foot of the range, of the same character and order of magnitude as that actually observed.

It must be added that this explanation can only be taken as applying to the Himalayas; the conditions in the Vindhya are entirely different and require to be considered apart.

THE REVIEWER.

PIANOFORTE TOUCH.

WHEN the editor of *Popular Mechanics* submitted a list of modern inventions to a referendum to select the "seven principal wonders of the modern world," the piano-player and player-piano were conspicuous by their absence from the long collection, although they possess quite as many features of scientific interest as many of the inventions actually submitted. These mechanisms have, moreover, failed, for some not very obvious reason, to form the subject of discussion in scientific and technical journals where frequent mention is made of such proprietary inventions as motor cars, gramophones, kinematographs and the like. Yet a number of subjects for scientific discussion may be suggested in connection with piano-players. The psychologist, for example, will notice that after a very little experience the performer does not consciously move his regulator to play faster or slower; but he unconsciously plays the notes at the exact instants that he thinks of them quite as much as if he were striking the keys with his fingers.

The attempt to compare pneumatic playing with finger playing in the matter of "touch" lands us in a very difficult problem of dynamical acoustics which has not received so much attention as it deserves from physicists. We are told that the piano-player cannot reproduce the clear singing *pianissimo* of the finger pianist, that there is a certain element wanting which only the human fingers can supply. What is this element? A piano-player can be played as softly or as loud as is desired, it allows full use of the pedals, and a slight jerk of the time lever enables the performer to "linger on a note" as well as an ordinary pianist. But still, we are told, the "touch" is not the same, and if a few notes are played from the music roll and then played with fingers, a certain difference in the quality of the tone often appears noticeable.

Now the quality of a note, apart from its actual loudness, depends on the relative intensity of the fundamental tone and its several harmonics, and we are thus led to inquire into the question how far the harmonics of a pianoforte note are capable of being intensified or reduced independently of the fundamental tone.

It is obvious that great differences in quality are produced by the use of the loud pedal, and the old-fashioned soft pedal which shifted the hammer off one of the strings and caused a softer part of the hammer to strike the others had an equal effect; moreover, the singing qualities and delicate harmonics are quite destroyed by shutting up a piano and covering it with ornaments. But even when other conditions are kept constant, differences are noticeable according to whether the same note is struck with a sharp blow or a heavy pressure, and we are thus led to the important question: *Are the intensities of the fundamental tone and its harmonics functions of one variable only, or are they functions of two or more variables?*

Now upon this point I find that a great disagreement of opinion exists. Many piano-makers in this country hold to the single-variable hypothesis on the ground that when the hammer is striking the strings it is disconnected from the keys; if this were not the case the note would be "blocked." On this hypothesis the striking velocity of the hammer constitutes the single independent variable. The single-variable theory is not inconsistent with the possibility that the character of a note may vary according to its loudness; this only requires that the intensities of the various components shall be different functions of the same variable instead of being multiples of the same function.

Other people will tell us that if it were possible to produce differences in the quality of a pianoforte note, they would be too small to be appreciable.

In Germany, on the other hand, I am informed that great importance is attached by teachers of the pianoforte to differences in the manner of applying pressure to the keys. During the small interval of time that the key is being depressed, this pressure is an arbitrary function of the time, or, if preferred, of the displacement, the form of the function depending on the action of the fingers and in particular on their elasticity, and the German method distinctly assumes the existence of a relationship between the form of this function and the quality of the note sounded.

Neither Helmholtz's nor Kaufmann's theories afford an explanation of the "two-variable" hypothesis. I believe other papers have been published dealing with this question, both experimentally and theoretically, and I hope the present article will be the means of eliciting information on the subject. It is evident that such investigations have not become widely known among physicists. From the point of view of applied mathematics, the difficulty of the problem consists in finding fundamental assumptions which lead to the desired conclusions, and are at the same time consistent with the structural conditions as they exist in the pianoforte. Two possible explanations suggest themselves:—

1. Although the hammer is at a slight distance from the wires in its position of *equilibrium*, it may still be acted on by some impressed force while touching the string, owing to the elasticity of the connections.

2. The stem of the hammer is flexible and capable of independent vibration, so that the circumstances of the impact may depend on the bending set up in projecting the hammer.

I am now investigating the equations of motion based on these two alternative assumptions, but the problem is a very difficult one, and it seems desirable to obtain further experimental evidence before any final conclusions can be reached.

For some time past I have obtained results with a piano-player which exhibit conspicuous discrepancies from what one would expect on the single-variable theory, and a good deal of care has been exercised in ascertaining that these effects are not due to mere imagination. My experiments have been so far directed towards the question as to how far differences of dynamical touch can be made to produce effects that can be noticed by an ear not specially trained to observe them. The apparatus used in these experiments consists of a horizontal lever fixed in front of a piano-player of the usual standard type; the short arm of this lever is connected by a wire passing over pulleys, or by some other connection, with the small auxiliary bellows of the player, and acts directly on it, the usual spring being removed. The lever carries a sliding weight by which the collapsing tension of the bellows can be regulated. When the bellows collapses it closes a kind of throttle valve in the mechanism, thus cutting the air off and producing an action similar to that effected by a short sharp impulse applied to the pianoforte keys. By increasing the load, by shifting the weight towards the end FF, a heavier sustained pressure is produced.

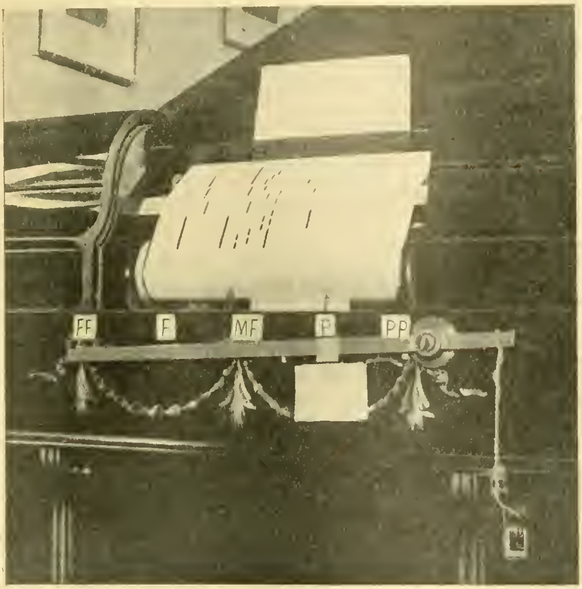

FIG. 1.—Apparatus (provisionally protected) for controlling the touch of a piano-player.

When the same passage is played first with the weight at PP and then with it at FF, a noticeable difference is observed. The loudness can be made about the same in both cases by suitably altering the pressure on the pedals, but in the former position the result is a brilliant "metallic" effect in which the treble notes stand out conspicuously, while in the latter position soft, mellow tones are produced in which the bass notes predominate.

The differentiation between bass and treble parts of chords is not necessarily inconsistent with the single-variable theory, since the hammers are of different mass in different parts of the scale, and therefore undergo different accelerations when the same variable force is applied to them. This dynamical differentiation is more satisfactory than the popular mechanical arrangement for controlling the two halves of the keyboard, as it involves no hard and fast dividing line.

In a passage involving chords it is impossible to separate the effects due to differences between the notes of a chord from any possible differences between the harmonics of the notes, and therefore it is necessary to choose a solo passage in order to effect a decisive test. I have shown such tests to a good many people; a few notice either no differences or only very slight differences. On the other hand, it is very surprising to find how many people notice conspicuous differences, and those who are most successful in detecting them are often people with no ear for music and no previous musical training. In most cases I ask them to describe what they observe without previously preparing them. It is thus evident that the dynamical effects dependent on these differences of touch, so far from being negligible, must have a marked influence on the impressions formed by a large proportion of both the musical and unmusical people who attend a first-class pianoforte recital.

Something more than merely sliding a weight is necessary to approximate to the rendering of a good pianist, who can vary his action on the keys from one note to the other. To effect the same result the lever must be controlled by hand as well, being pressed or jerked from above or below practically in an unlimited variety of ways. An almost infinitesimal touch of the finger will often cause a particular note to ring out brilliantly. In the commercial player the performer has to depend mainly for these effects on his feet. Now not only are feet much less sensitive than fingers, but the effects are so modified by the elasticity of the various springs that these latter have a predominating influence in governing the touch, and a considerable effort on the part of the performer often produces only a slight difference in the result.

A remarkable instance of how a trifling cause may greatly modify pianoforte tones was shown in a recent demonstration at the Physical Society, when the effects were observed to be rather loud and harsh. In this case a copper wire was used for the connection between the lever and bellows instead of one of steel. On trying the copper connection at home the effects were identical with those shown at the Imperial College.

In this country little attention is paid to pianoforte touch, owing, probably, to the use of boxed-up pianos covered with jangling ornaments, when sufficient volume of sound has to be obtained by violently hammering the keys and bobbing down the pedals through harmonics and discords. Moreover, the average pianoforte pupil has too much to do with learning execution to trouble about "touch," and very few professionals produce variations in the quality of their notes at all approaching the possible maximum. It is not surprising, therefore, to find widespread belief in the single-variable theory. At the same time, I do not consider it possible to overlook the numerous results of independent observation which are inconsistent with that theory.

It is much to be hoped that the increasing popularity of the player-piano will lead to increased interest in the more scientific aspects of piano-playing.

The explanation of the acoustical effects produced by the modern pianoforte is probably a dynamical problem of considerable complexity, depending on a number of causes, many of which have hitherto been neglected. It is important that not only should attention be directed to any investigations bearing on the matter which have commonly been overlooked, but that further experiments should be carried on with the object of better localising the apparent discrepancy which exists between theory and observation.

G. H. BRYAN.

AGRICULTURAL EDUCATION.

FOR many years past technical education of a more or less efficient kind has been provided for the majority of our leading industries, but for some reason or other our greatest industry of all, and that on which indirectly all the others depend, has been left with scarcely any provision at all. It may be that this is due to the fact that agriculture is the nurseling of one Government Department and education of another, and that under our rigid red-tape-bound system, agriculture has no dealings with education. It gives peculiar pleasure, therefore, to note that this system shows signs of amendment, and one of the firstfruits of reform is seen in a memorandum recently issued by the Board of Agriculture and Fisheries to local authorities in England and Wales offering grants from the newly-established development fund towards the furtherance of technical instruction in agriculture and horticulture.

The grants promised are intended to aid (1) in the establishment of advisory councils to be set up in each county or group of counties for the purpose of reviewing, governing, and co-ordinating or initiating schemes for providing higher agricultural education and educational experiments in connection therewith; (2) in the provision and maintenance of buildings and lands for farm schools and farm institutes, at which young agriculturists and others whose daily business is connected with the land may obtain scientific and practical instruction in the technicalities of their art. At each of these schools and institutes it is intended that a highly efficient staff shall be maintained to give short courses of instruction in summer and winter suited to the requirements of the district, also to conduct experimental and research work, and to which agriculturists can apply for advice in cases of difficulty. The grants for farm schools and institutes may be partly annual where new or additional work is being undertaken.

Somewhat stringent conditions are laid down for the administration of the grants to prevent their being applied to the relief of the ratepayers in those districts where such work has already been begun, but that these districts may not be discouraged, the proportion of the grant to the actual expenditure may vary from 50 to 75 per cent., having regard to the financial burden hitherto undertaken by each local authority in this direction.

A covering letter directs attention to the leading provisions of the memorandum, and gives, amongst other things, the Board's ideas with regard to the appointment and duties of a responsible official or organiser in each county or division. The success or otherwise of the scheme will depend very largely upon whether the right man is or is not found for this important post, and as suitable men cannot at the present time be very plentiful, the authorities will be well advised not to insist too rigidly on the paper qualifications of the candidates, but to judge each on his merits, past performances, and experience in agricultural education and organisation.

The scheme outlined contains the germ of an excellent system, but its success or failure will depend largely upon the skill and tact with which it is developed. When the curricula and atmosphere of our rural elementary and secondary schools have been reformed so as to complete the scheme, and the inherent prejudices of the farming community have been overcome, we may hope for a good return for the money spent, but we must not look for abundance of fruit before the tree has had time to take root and expand its branches. Progress will doubtless be slow, and much patience, skill, and trouble will have to be expended before a crop may be looked for.

WILLIAM ALDRIDGE.

NOTES.

AT the meeting of the Linnean Society on May 1 Prof. Hermann von Vöchting was elected a foreign member, and the president announced that it had been decided to award the Linnean medal to Prof. Adolf Engler.

THE council of the Manchester Literary and Philosophical Society has nominated Sir Thomas H. Holland, K.C.I.E., F.R.S., to represent the society at the twelfth International Congress of Geology, to be held in Toronto in August next.

A MESSAGE from the Wellington correspondent of *The Times* on May 1 says:—Miss Procter's mission to New Zealand to urge the establishment of a solar physics observatory has been successful. Mr. Cawthron, a citizen of Nelson, has offered to give the 10,000*l.* to 12,000*l.* which is estimated to be the sum required.

THE annual autumn meeting of the Institute of Metals will this year, under the presidency of Prof. A. K. Huntington, be held on the Continent, for the first time since the institute's formation in 1908. It will take place in connection with the Ghent International Exhibition, the dates fixed being ugust 28–30. Among many important papers to be communicated will be the report of the corrosion committee.

AT a meeting of the Mansion House Committee of the Captain Scott Fund on Monday, May 5, the Lord Mayor announced that the combined funds, including that of *The Daily Telegraph*, amounted to 56,129*l.*, of which 12,493*l.* had been assigned for supplementing the Government provision for the relatives, 1848*l.* towards discharging the liabilities incurred by the expedition and the publication of the scientific results, and 6112*l.* for a memorial, leaving the allocation of the balance, 35,675*l.*, to the discretion of the committee. A committee was appointed to consider and report upon the form the memorial should take.

As announced already, a joint meeting of the Institution of Electrical Engineers with the Société Internationale des Electriciens will be held in Paris on May 21–24. The following papers will be discussed at the meeting:—High-tension continuous-current traction, M. Gratzmuller; single-phase traction, M. Latour; the electrification schemes of the Chemin de Fer du Midi, M. Jullian; the electrification of the Paris suburban lines of the State Railway, A. N. Mazen; railway electrification problems in the United States, H. Parodi; petrol-electric motor trains, J. B. Damoiseau; long-distance transmission of electric energy (continuous current), J. S. Highfield; long-distance transmission of electric energy (three-phase current), M. Leblanc; automatic telephony: application of mechanical devices to the assistance of manual operating in telephone exchanges, W. Slingo.

THE Historical Medical Museum, organised by Mr. Henry S. Wellcome, which is to be opened in London towards the end of June next, will include some objects of particular interest. An important exhibit in the science section will be a large collection of the original apparatus used by Galvani in making his first experiments in galvanism in the eighteenth century. Other exhibits will be a collection of votive offerings for health, ancient microscopes, and optical instruments, amulets and charms connected with English folk medicine, early medical medals and coins from the Græco-Roman period, and early manuscripts and medical books.

ARCHÆOLOGISTS will welcome the announcement that the famous prehistoric camp, known as Maiden Castle—Maidun meaning "Hill of Strength"—near Dorchester, has been, at the suggestion of the King, purchased by the Duchy of Cornwall, and will now be carefully preserved. The camp dates from Celtic times, and formed a shelter for cattle during tribal raids rather than a military fortress. Water was supplied from a Neolithic dew-pond on the summit of the plateau, and the palisading kept at bay wolves and other enemies, while the cattle were left in charge of a few women and children. The cunningly arranged entrances to the camp supply a remarkable example of primitive methods of defence.

AT the annual general meeting of the Marine Biological Association of the United Kingdom, held in the rooms of the Royal Society on April 30, the following officers and members of council were elected for the year:—*President*, Sir Ray Lankester; *Chairman of Council*, Dr. A. E. Shipley; *Hon. Treasurer*, Major J. A. Travers; *Members of Council*, E. T. Browne, L. W. Byrne, Dr. W. T. Calman, Prof. H. J. Fleure, Prof. F. W. Gamble, Sir Eustace Gurney, Commander Campbell Hepworth, Prof. J. P. Hill, E. W. L. Holt, Prof. E. W. MacBride, H. G. Maurice, Dr. E. Schuster, G. W. Smith, Prof. D'Arcy W. Thompson; *Hon. Secretary*, Dr. E. J. Allen. The following governors are also members of council:—G. P. Bidder, the Earl of Portsmouth, Sir Richard Martin, the Hon. N. C. Rothschild, Prof. G. C. Bourne, Dr. A. E. Shipley, Prof. W. A. Herdman.

AT the annual general meeting of the Institution of Civil Engineers, held on Tuesday, April 29, the result of the ballot for the election of officers was declared as follows:—*President*, A. G. Lyster; *Vice-Presidents*, B. H. Blyth, J. Strain, G. R. Jebb, A. Ross; *other Members of Council*, J. A. F. Aspinall, J. A. Brodie, W. B. Bryan, Col. R. E. B. Crompton, C.B., J. M. Dobson, Sir H. F. Donaldson, K.C.B., E. B. Ellington, W. H. Ellis, W. Ferguson, Sir Maurice Fitzmaurice, C.M.G., Sir J. P. Griffith, Dr. C. A. Harrison, W. Hunter, H. E. Jones, Sir Thomas Matthews, Dr. W. H. Maw, C. L. Morgan, B. Mott, A. M. Tippett, Sir Philip Watts, K.C.B., W. B. Worthington, Dr. Dugald Clerk, F.R.S., R. S. Highet, Dr. E. Hopkinson, F. Palmer, and H. N. Ruttan.

THE annual meeting of the Iron and Steel Institute was held on May 1–2, when the Bessemer gold medal for 1913 was presented to Mr. Adolphe Greiner by the president, Mr. Arthur Cooper. In making the presentation, the president said Mr. Greiner was in 1864 appointed chemical engineer, and in 1887 general director of the steel works of Messrs. John Cockerill, Seraing, Belgium. He was responsible for the introduction into Belgian iron and steel practice of the basic processes, and has been to the front in the utilisation of blast furnace and coke oven gas. The Andrew Carnegie gold medal for 1912 was presented to Dr. J. Newton Friend. The annual dinner was held on the evening of May 1. Mr. R. Elliot-Cooper, president of the Institution of Civil Engineers, spoke of the importance of the work of standardisation of materials, in which the institute has been engaged. Sir Alexander Henderson in the course of a speech remarked that science has done more for the iron and steel industry than for any other. The president of the institute said the growth of the iron and steel industry is seen in the fact that during the life of the institute the production of steel has grown from 600,000 to 60,000,000 tons per annum.

IT would appear from the recent annual report of the Decimal Association that the General Medical Council has announced that all measures and weights in the new British Pharmacopœia, including those referring to dosage, will be in the metric system, and that in order to facilitate the use of the work by medical men, the equivalents for dosage will also be given in the Imperial system. Further progress is also reported in connection with the adoption of the metric carat of 200 milligrams as an international unit for the sale of diamonds and precious stones. Owing, no doubt, to the steady advance made by this unit on the Continent, the views of the trade in this country with respect to it appear to have undergone considerable change recently, and to be now generally in favour of the legalisation of the metric carat. It is confidently expected that steps will be taken very shortly by the Government to issue an Order in Council legalising the metric carat, as well as a series of multiples and submultiples of that unit. The effect of this legislation will be to render the present arbitrary and unrecognised carat illegal and to bring the weights and balances used by merchants and dealers for the sale of precious stones by weight under the purview of the local inspectors of weights and measures. A law has recently been passed in Belgium making the use of the metric carat obligatory in that country, and it is anticipated that a similar step will be taken at an early date in the United States, and possibly also in Russia.

WE understand that the Easter vacation season, just concluded, at the Port Erin Biological Station, has probably, taken all round, been the most successful one yet held. The number of senior students and of post-graduate researchers at work in the institution during March and April was above sixty. *Amphidinium operculatum*, the minute brown dinoflagellate which was found for the first time in Britain at Port Erin a couple of years ago, and has kept on occurring since from time to time in vast quantities, was present in abundance during the greater part of April, and was the subject of some interesting experiments and observations. The marine plankton was abundant during the greater part of the vacation, and the catches showed, early in April, the spring diatoms making their appearance in great numbers—at first round the coast on both east and west sides of the island; and not appearing out at sea (*e.g.* at the five-mile station) until a week or so later. Unusually large quantities of floating fish eggs seemed to be present in the tow-nets out at sea (the species have not yet been identified, nor the exact numbers in the hauls estimated), and the results in the fish hatchery attached to the biological station have been exceptionally favourable. The hatching work is still in progress, spawning is not quite finished, so final figures cannot yet be given, but it looks as if this year might be a record one in fish-hatching. By April 24 more than eight and a half millions of plaice eggs had passed into the hatching boxes, and above seven millions of hatched fry had been distributed out at sea.

AT a meeting of the Society of Engineers (Incorporated), held on Monday, May 5, a paper on tidal waters as a source of power was read by Mr. C. A. Battiscombe, the object of the paper being to direct attention generally to the commercial possibilities of hydro-electric installations in the British Isles, more particularly with regard to the use of the tides. After some introductory remarks in reference to tidal intervals and the range of neap tides, the author pointed out that in this connection the head of water available for actuating turbines cannot exceed one-third of the range of minimum tides. An outline was given of the arrangements proposed for the constant maintenance of a working head, by means of a chamber for the turbines, connected by valves to the tidal way and to three reservoirs in which the tidal water may be impounded. It was claimed that the utilisation of the tides for power purposes presents few engineering difficulties so far as principles are concerned, but that the real difficulty lies in the question of cost, and therefore in the choice of the site and in the design of the structural details. The author concluded by insisting on the importance of regarding the supply of fuel as a matter that concerns the whole nation: that the demand for combustible fuel is continually increasing, and that coal being practically the only fuel found in England, it would be mere folly to neglect any other available source of energy whereby the present rate of consumption of coal may be sensibly reduced. It was submitted that not only can the tides be utilised as a constant source of power, but that, taken in conjunction with the power that could be derived from fresh-water rivers, their utilisation would be a great gain to the commercial and industrial interests of the United Kingdom.

THE majority of the papers read before the first International Eugenics Congress, held in London in July, 1912, were published at the beginning of the congress in a volume entitled "Problems in Eugenics." Some, however, were received too late to be included therein, and these, together with a report of the discussions which took place at the congress and the speeches which were delivered at the inaugural banquet, have now been published in a supplementary volume ("Problems in Eugenics," vol. ii.; London: The Eugenics Education Society, 1913, pp. 196). In the preface Major Leonard Darwin directs attention to the fact that an international eugenics committee has been established on a permanent basis as a result of the congress. The primary object of this committee, which will meet in Paris next August, is to settle questions connected with the future assembly of eugenics congresses, but it is hoped that it may also fulfil the useful function of a clearing-house for information on eugenic matters.

THOSE who are prepared to accept the view that many, or all, megalithic monuments were designed for the purpose of astronomical observations will be interested in an elaborate paper by Dr. Marcel Baudouin, entitled "Le siège d'observation de Chergiroux à l'Ile d'Yeu (Vendée)," published in vol. iii., sixth series, parts 5 and 6, of the *Bulletins et Mémoires de la Société d'Anthropologie de Paris* for

1912. The learned author has discussed the question with much care and learning, and though some may still hesitate to accept his conclusions, his communication deserves the attention of all who are interested in the astronomical aspect of megalithic monuments.

The attention of students of African ethnology may be invited to an important paper, "Notes on the Geographical Distribution of the Hottentot and Bantu in South Africa," by Mr. W. H. Tooke, published in part v., vol. ii., of Records of the Albany Museum of Grahamstown. The cradle of the Hottentot race he believes to have been the region now occupied by the Hamitic tribes—Berbers, Gallas, Somali, and Masai. But there are mixed races containing negro, Semitic, and Caucasian elements, and the problem remains whether any of these tribes are derived from a prototype of which the Hottentot is evidently, from close conformity to persistence of type, the present representative. He groups the Bantu into four divisions—inland, including the Makalanga and the Bechwana; coastal, the Baronga or Tekeza, and the Zulu-Xosa or Zulu-Kaffir. The movements of these groups are intricate and obscure, but the information collected by Mr. Tooke will help towards a scientific solution of these tangled problems. The importance of the study of stone implements in the same region was urged in his lecture, delivered on February 29, before the African Society by Prof. Henry Balfour, on the earliest inhabitants of South Africa.

To the April number of *The Geological Magazine* Mr. R. B. Newton contributes a note on the fossils in the Pennant collection, recently presented to the British Museum (Natural History) by Lord and Lady Denbigh. These include about a thousand specimens, some of which were described and figured by Pennant himself. A selection has been placed on exhibition in the geological department.

The extent to which the native fauna is disappearing in Victoria may be inferred from the following paragraph relating to the Darby district in the March number of *The Victorian Naturalist*:—"Only a few years ago the koalas, or native bears, were numerous, and could be seen here at any time. Wallabies, dingoes, and the introduced hog-deer were also common, but are now replaced by the fox."

In the Bulletin of the American Museum of Natural History, vol. xxxii., art. 2, Mr. R. J. Coles records a method of obtaining embryos of large rays. Having observed that female rays appeared to have expelled their embryos in their struggles when taken in nets, the author resorted to the plan of jumping into the water as a seine containing a ray was drawn into the shallows, stabbing the fish with a knife in the back of the head, and then holding on to the knife-handle with one hand, and plugging the vent with the other. The fish was then dragged ashore, when the young would be ejected on the sand. The author then describes, with illustrations, the embryos of several species, and also adduces evidence to show that there is a regular northward summer migration of certain tropical species of rays along the Atlantic coast of North America.

In an article on the late Prof. Alpheus Hyatt and his principles of research, published in the April number of *The American Naturalist*, Dr. R. T. Jackson emphasises the importance of these researches in respect to the phylogeny and mutual relationships of invertebrates. Stages in development, more especially post-embryonic, were a favourite subject with Hyatt, who inculcated the law that the development of the individual is an epitome of that of its group. He also insisted on the importance of a due recognition of parallelism in development, and originated the theory of acceleration of development, as well as directing attention to senile degenerate development. In conclusion, the biographer expresses the belief that in the future "Hyatt will be looked on as the master-mind who pointed out the methods by which to ascertain the true phylogenetic relations of invertebrate organic forms."

The first part of vol. cv. of the *Zeitschrift für wissenschaftliche Zoologie* contains three papers of considerable interest to embryologists. The first, by Theodor Baumeister, deals with some early stages in the development of the hedgehog. As this animal is sometimes regarded as the oldest living mammal it has already received a large amount of attention at the hands of embryologists, but the present memoir serves to fill an important gap in our knowledge. The second, by Eva Krüger, treats of the reproduction and gametogenesis of the nematode *Rhabditis aberrans*, n. sp., while the development of a more familiar nematode, the well-known fresh-water form, *Gordius aquaticus*, claims the attention of N. Th. Meyer. The segmentation of the egg in the species last-named has been worked out in detail, and the figures are sufficiently convincing. The process of gastrulation, however, appears to take place in a very remarkable manner. The mesenchyme is stated to be formed by an early unipolar immigration, while the alimentary canal arises from two opposite invaginations which meet and fuse together to form a tube, the hinder of the two forming both midgut and proctodæum. The proboscis arises as a second invagination of the anterior end. The author himself appears not quite to be convinced as to the correctness of his account of the formation of the alimentary canal.

Among the most recent publications of the Department of Applied Statistics, University College, London, is an investigation into the mortality of the tuberculous after sanatorium and tuberculin treatment, by Mr. W. Palin Elderton and Mr. Sidney J. Perry. The data from which they worked consisted of records of 3000 cases from the Adirondack Cottage Sanitarium, provided by Dr. Lawrason Brown, of smaller numbers from Scottish sanatoria, provided by Dr. Rest and Dr. Guy, and of particulars of cases dating from 1845 to 1870, from the case books of Dr. Austin Flint, which serve as a guide to the mortality of the consumptive in America in pre-sanatorium days. The most interesting of the conclusions arrived at is stated by the authors as follows:—"There is no evidence in the mortality shown from the data before us to prove that tuberculin as compared with ordinary sanatorium treatment appreciably lengthens the life of the consumptive. If the use of tuberculin had the very marked results claimed by some of its supporters we should have anticipated more definite evidence of its effect on mortality."

A recent memoir by Capt. R. T. Wells on dysentery in Haziribagh Central Jail (Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India, No. 52) contains a number of important data bearing on the question of the relation of amœbæ to the causation of dysentery. From this, as well as from other recent investigations, it is very clear that great care must be taken to distinguish clearly between harmless contamination-amœbæ and the pathogenic amœbæ which are the true cause of the disease. Contamination-amœbæ can be cultivated from fæces, tap-water, and other materials by planting them on Musgrave's medium; their cysts are air-borne, and readily gain access to fæces or specimens of pus, however carefully collected, or to any material planted on Musgrave's medium contained in Petri dishes. The true dysenteric amœbæ differ in their microscopic characters from the contamination-amœbæ, and they do not live more than a few hours after discharge from the body, whether transferred to Musgrave's medium or not. The failure to distinguish between these two types of amœbæ has led in many cases to very erroneous conclusions being drawn.

To *Symons's Meteorological Magazine* for April Mr. R. C. Mossman contributes the second of his interesting papers upon Southern Hemisphere seasonal correlations, showing that in the month of May a pronounced opposition exists between the barometric pressure at Stykkisholm, Iceland, lat. 65° N., and Laurie Island, South Orkneys, lat. 61° S. The corrected mean pressure at these two places for the month in question, for the years 1902–11, was respectively 29·91 and 29·32 in. An examination of the barometric data at other places shows that in South America, south of about lat. 47°, the pressure departures are in harmony with those at South Orkneys and South Georgia; but data from intertropical and other regions, *e.g.* the Azores, United States, &c., show indefinite results. The author therefrom concludes "that the dominating factor influencing these May pressure variations in the North and South Atlantic is to be found in the polar regions." As to why the striking differences obtain only in the month of May no explanation is offered. Some interesting notes are also made relating to the variations of wind circulation accompanying the differences of pressure in the extreme South and far North Atlantic.

The February number of *Lěss* (*The Forest*) contains articles on the influence of forests on the soil, climate, salubrity, &c., questions already much discussed, and on the modifications caused by man in the distribution of birds. Some birds frequent human habitations to build nests on house roofs, or to obtain food, especially in winter. Wading birds have been driven away by the draining of marshes, and the destruction of woods has deprived certain species of their natural nesting-places, while the fields and meadows which have taken their place have attracted other species. Instances are given of the effect of these changes in Russia.

During the solar eclipse of April 17, 1912, determinations of magnetic declination were made by a number of observers in order to detect any direct action of the eclipse on the magnetic state of the earth. The general verdict was that the effect, if it existed at all, was very small. Dr. S. Kalinowski, of Warsaw, however, directed attention in the October, 1912, number of *Terrestrial Magnetism* to the decided difference in the declination curves obtained by him during the eclipse, and at the same hours on the preceding and following days. The normal increase in the westerly declination was replaced by a small decrease followed by a rather rapid increase. Dr. Kalinowski pointed out that the same effect was exhibited in a less marked degree in the curves obtained at Beuthen, but that the Potsdam curves did not show it. In a letter to the editor of *Terrestrial Magnetism*, published in the March, 1913, number, Dr. S. van Dijk states that the curves obtained during the eclipse at De Bilt, Holland, show an effect of the same character as that found by Dr. Kalinowski.

Messrs. Williams and Norgate inform us that in the advertisement of some of the volumes in the Home University Library, announced in last week's issue, "An Introduction to Mathematics" was, through an oversight, attributed to the Hon. B. Russell in place of Mr. A. N. Whitehead, F.R.S. The volume is correctly advertised in the present issue.

OUR ASTRONOMICAL COLUMN.

The Spectra of Nova Geminorum.—In the publications of the Allegheny Observatory of the University of Pittsburg (vol. iii., No. 3) Mr. F. C. Jordan gives a description of eighteen spectrograms of Nova Geminorum (No. 2). The first of the series of photographs was secured on March 16, when the bright lines were strongly developed on the plate, and the absorption lines a little less so, and the last on April 14, when no absorption lines were detected at all. The author gives tables of the wave-lengths determined, and a series of intensity curves. He mentions the curious fact that with regard to the H and K absorption lines the weighted means of the velocities deduced from them yield a curve which follows to some extent the light variations of the nova, the velocities being positive when the star is brighter and negative when it is fainter. Mr. Jordan suggests that it would be very desirable to examine the velocity determinations from plates secured at other observatories, and for this and other points of view he would place all the plates he secured at the disposal of any astronomer or institution that may decide to undertake such a discussion.

Another paper of importance in connection with this nova is that printed in the Monthly Notices of the R.A.S. (vol. lxxiii., No. 5, p. 380). The authors, Prof. H. F. Newall and Mr. F. J. Stratton, describe a detailed study they have made of the spectrum of the nova on March 15, and they come to the conclusion that the absorption lines are for the most part identical with the lines in α Cygni, and to a small percentage in γ Cygni; or, in other words, the nova spectrum of that date was an enhanced-line spectrum. The authors refer to the previous work of Sir Norman Lockyer at South Kensington, who showed that in the case of Nova Persei its bright-line spectrum was composed for the most part of α Cygni, or enhanced lines. Thus the origins of most of the nova lines at this stage of its history will now be considered as more definitely settled. The paper is accompanied by an excellent plate showing the nova spectrum and comparison spectra.

Radial Velocities of Stars with the Prismatic Camera.—Some time ago Prof. E. C. Pickering suggested a means of determining the radial velocities of stars from prismatic camera photographs by inserting in the optical train a medium which produced a sharp absorption line in the stellar spectrum. Mr. R. W. Wood found out that the absorption line of neodymchloride at λ4273 A.U. in a weak solution was of prominent sharpness. Prof. Schwarzschild has now used this filter in connection with an objective prism, the instrument being a Zeiss triplet of 150 mm. aperture and 1494 mm. focal length, and a prism of the same aperture giving a dispersion from Hγ to K of 10·3 mm. He placed the cell a few millimetres in front of the photographic plate, the former being about 8 mm. in thickness, and containing a weak solution, the proportion being 1 to 6. In *Astr. Nachr.*, No. 4646, he gives an account of the results he secured, using the star α Coronæ borealis, the spectrum of which is not very favourable for the research, as the lines are hazy, though the orbit is well known. At least four spectra near each other were taken on the plate, and photographs were secured on eighteen evenings. Prof. Schwarzschild describes in detail the methods of measurement and reduction, and states that the probable error of the mean of six spectra in an evening is ±5·7 km./sec., and the probable error of a single spectrum ±13 km./sec. He points out that Mr. Jordan, with a photograph taken with a slit spectroscope, obtained probable errors of 4·2 to 5·5 km./sec., according to the kind of plate used, and Mr. Cannon a value amounting to ±5·4. The observations corroborate Jordan's period of 17·36 days.

Meteorite from Kansas.—A reprint from the Proceedings of the U.S. National Museum (vol. xliv., p. 325) contains an account of a newly found meteorite from near Cullison, Pratt County, Kansas, by George P. Merrill, head curator of geology of the National Museum. The stone is described as having struck the earth in December, 1902, but it was not found until 1911. Mr. Merrill was thus confronted with the doubt as to whether the stone was the one actually seen to fall, but he found that a thin section indicated the meteoritic nature of the stone at once. Besides showing special interest from the diversity of the chondritic forms which it carried, another feature was a somewhat indistinct wavy banding visible only on a polished surface of a section. The paper, besides giving illustrations of the stone as found and polished surfaces, contains chemical and mechanical analyses of the stone, and the following is the composition of the stone in bulk, omitting percentages of substances less than unity:—

	Per cent.		Per cent.
Silica	35·30	Soda	1·80
Alumina ...	4·24	Sulphur ...	2·18
Ferrous Iron ...	8·38	Nickel	1·80
Magnesia ...	23·63	Iron	21·27

Royal Astronomical Society of Canada.—The January–February number of the Journal of the Royal Astronomical Society of Canada (vol. vii., No. 1) contains much interesting reading, and attention is directed especially to two communications. The first is the address of the president of the society, Prof. L. B. Stewart, delivered at the annual meeting, and has for its title, "The Structure of the Universe." In this be brings together most of the more important recent researches relating to this subject, including such investigations as deal with star streams, proper motions of separate groups, absorption in space, &c. The second article is a delightful account of Mr. John A. Brashear's visit to the home of Dr. Thomas Dick, the Christian philosopher and astronomer. Mr. Brashear came over in 1911 for the fifth centenary celebration of St. Andrews University, and after listening to the opening addresses, as he says, "I could not resist the temptation to slip away" and make a visit to Broughty Ferry, near Dundee, the home of Dr. Dick. Mr. Brashear is full of enthusiasm of the reception he received at the hands of the present owners, and brings together some very interesting notes relating to episodes in Dr. Dick's career; numerous illustrations accompany his communication.

THE ERUPTION OF THE KATMAI VOLCANO, ALASKA, ON JUNE 6, 1912.

In *The National Geographic Magazine* for February of the present year there appears a very interesting account of the eruption of Katmai, in Alaska, which commenced on June 6, 1912. The Katmai Volcano (7500 ft.) is one of ten or twelve more or less active volcanoes known to exist in the Alaskan peninsula, though probably a still greater number occur in the adjoining Alaskan islands. The report is furnished by Mr. G. C. Martin, who was dispatched by the National Geographic Society of Washington to collect information as soon as the news of the eruption arrived by telegraph. This report, which is illustrated by a map and numerous photographs, shows that the outburst resembled in all its main features that of Krakatoa in 1883, though, happily, owing to the very sparse population of the district, the damage done was comparatively small, and no human lives were lost. No lava-streams are recorded as having been seen, but the eruption, which included three outbursts of excessive violence within two days, consisted in the discharge, first of pumice, and afterwards of dust of gradually increasing degrees of fineness. In the sea, twenty miles from the volcano, floating pumice was accumulated to such an extent that men could walk upon it. At Kodiak, 100 miles from the volcano, dust fell, causing complete darkness for sixty hours, and accumulated to a general depth of 10 to 12 in. Roofs were broken down by the weight of this dust, and houses wrecked by the avalanches of it which descended from the hills. Dust was recorded as having fallen 900 miles away, and if vessels had been in those seas it would probably have been noticed much farther off. Probably great changes were produced in the volcano itself, for one observer declared that half the mountain was gone.

This report is followed in the same journal by an article from the pen of Dr. C. G. Abbot, the director of the Astrophysical Observatory of the Smithsonian Institution, Washington. From observations made by himself in Algeria, where he happened to be at the time of the Katmai eruption, and from communications he received from Mount Wilson, in California, Mount Weather, in Virginia, and other localities in different parts of the globe, he infers that a similar world-wide diffusion of the fine volcanic dust took place as was observed in the case of the Krakatoa eruption, and he discusses the question, "Do Volcanic Explosions Affect our Climate?"

THE SPECTROSCOPE IN ORGANIC CHEMISTRY.[1]

SOMEWHAT more than half a century ago, while engaged, with the assistance of Faraday, in preparing experiments for a Friday evening discourse in this institution, Stokes observed that the spectrum of the electric light extended to five or six times the length of the visible spectrum when he employed prisms and lenses of quartz instead of glass. This extension occurs at the violet end of the spectrum, and consists of rays of high refrangibility, to which the eye is insensitive, but which can be made apparent by means of a fluorescent screen.

At the time of this discovery, and in the years immediately following it, attention was being directed to the absorption of light by coloured solutions, and to the possibility of identifying coloured substances by the number and position of the dark bands in the spectrum of light transmitted through their solutions. Stokes saw that by his discovery of the extension of the spectrum beyond the visible region, this method of investigation might be applied to colourless as well as to coloured substances. In a paper communicated to the Royal Society in 1862, he says:—"Having obtained the long spectrum above-mentioned I could not fail to be interested in the manner in which substances—especially pure, but otherwise imperfectly known organic substances—might behave as to their absorption of the rays of high refrangibility." He proceeded, therefore, to study the action of various organic solutions on the ultra-violet rays, and found that the mode of absorption generally was so constant and so characteristic that by this single property many substances could be identified.

While Stokes was engaged in these researches, Prof. William Allen Miller was simultaneously at work in the same field, and Stokes left the further development of the subject in his hands. Miller improved the method of observation by substituting a photographic plate for the fluorescent screen, but he failed to "trace any special connection between the chemical complexity of a substance and its diactinic power." Struck by this fact, W. N. Hartley—now Sir Walter Hartley—commenced a systematic investigation of the whole subject, and it is to his researches, extending over a period of more than thirty years, that we owe, not only most of the knowledge which we now possess of the relation between the structure of organic substances and the action of such substances on the ultra-violet rays, but the elaboration of the convenient and elegant methods by which such investigations are now conducted.

The light derived from an ordinary source of illumination, such as an electric lamp, consists of waves of all degrees of refrangibility, and its spectrum shows a continuous band of colour ranging from red to violet. The limits of this visible spectrum lie between the wave-lengths 7600 and 3900.

If now, instead of the electric light or other ordinary source of illumination, we employ the light emitted by one of the metals when raised to a high temperature, the spectrum is seen to consist of a series of lines of different colours and intensities lying within the same limits as the visible spectrum. But there are rays beyond the red end of the spectrum and rays beyond the violet end which excite no sensation of luminosity in the eye. By allowing the spectrum to fall upon a screen which has been coated with a fluorescent substance, such as sulphate of quinine or a salt of uranium, tnese rays are rendered visible for a short distance beyond the violet. But it is only when we replace the glass apparatus, with which we have hitherto been working, by a quartz prism and lenses, and substitute a photographic plate for the eye, that the full extent of the spectrum beyond the violet is revealed. This is the ultra-violet region—the region which Stokes opened up to investigation, and it is with the behaviour of organic substances towards the rays of this part of the spectrum that we have mainly to do this evening.

FIG. 1.—1 Spark spectrum of nickel and iron. 2. The same, after the light has passed through quartz 10 mm. thick. 3. Crown glass 0·13 mm. thick. 4. Crown glass 0·33 mm. thick. 5. Window glass 1·62 mm. thick.

When light is transmitted through a coloured solution certain rays are absorbed, and dark bands corresponding to these rays appear in the spectrum. The importance of these bands as a means of distinguishing coloured substances has long been recognised, and, as we have already seen, considerable progress had been made with their study fifty years ago. As the bands in this case are in the visible spectrum, no special means are required for their observation.

But when we extend this method of investigation to colourless substances we are dealing with phenomena which lie hidden from the unaided eye, and our investigations are necessarily carried out with the help of photography.

The instrument employed in the study of absorption spectra consists of a spectroscope in which the eyepiece of the telescope is replaced by a camera. The

[1] From a discourse delivered at the Royal Institution on Friday, April 4, by Dr. J. J. Dobbie, F.R.S.

photographic plate is set at such an angle as to bring all the rays emanating from the source of light into focus at its surface after they have passed through the resolving prism, and for this purpose it is necessary that the plate should have a very slight curvature. The prisms and lenses of the apparatus are made of quartz, which, unlike glass, is readily permeable by the ultra-violet rays (Fig. 1). The source of light usually employed is that obtained by sparking one of the metals, such as iron, or a combination of metals, such as cadmium alloyed with lead and tin. In using the apparatus a photograph is first taken of the spectrum of the source of light. A layer of the substance to be examined, which, if a solid, must be dissolved in a suitable diactinic solvent, such as alcohol or water, is then interposed between the source of light and the slit of the collimator, and another photograph is taken. By comparison of the two photographs it is seen what effect, if any, the substance has had upon the transmission of the light.

When organic substances are examined in this way it is found that some allow light to pass freely through them. Others shorten the spectrum by absorbing the rays at the ultra-violet end to a greater or less extent, and are said to show general absorption. Others, again, possess the remarkable property of absorbing rays of a particular wave-length, thereby producing gaps or bands in the spectrum; these are said to show selective absorption (Fig. 2).

In studying these phenomena in their relation to the chemical characters of a substance, it is of importance to determine not only the extent of the general absorption and the number and position of the absorption bands, but their degree of persistence, *i.e.* the range of concentration within which they are exhibited. It is necessary, therefore, to vary the concentration of the solution or the thickness of the layer so as to cover the whole phenomena of absorption. This is done by simply diluting the solution, or diminishing the thickness of layer, on one hand, until the entire spectrum is transmitted, and on the other by increasing the concentration or the thickness of the layer until no further characteristic absorptive effect is produced. Photographs are taken at each concentration, and a curve is drawn connecting the concentration and the absorption as measured with reference to the lines of the metal employed as a source of light (Fig. 3).

If we now inquire whether the substances which affect light in one or other of the different ways already indicated have themselves anything in common, we find that it is with those which possess the structure characteristic of benzene and its derivatives that the power of absorbing the rays of particular parts of the spectrum is most frequently, although not exclusively, associated.

FIG. 2.—1. Spark spectrum of nickel and iron. 2 and 3. The same after the light has passed through water and solution of cane sugar respectively. Alcoholic solutions of (4) pinene, (5) thiophen, (6) citric acid illustrate general absorption, and alcoholic solutions of (7) isatin, (8) phenol (9) salicylic acid, (10) quinine hydrochloride illustrate selective absorption.

Organic compounds, or compounds containing the element carbon, are divided into fatty or aliphatic, in which the carbon atoms are united in an open chain, and cyclic, in which the carbon atoms form a closed chain or ring. Hexane, which is a constituent of liquid paraffin, may be taken as an example of the first class. This substance possesses the formula C_6H_{14}. It is highly diactinic or transparent to the ultra-violet rays, and nearly all compounds belonging to the same division of organic chemistry, such as alcohols sugars, and fatty acids, are either equally transparent to light, or only cut off a portion of the extreme ultra-violet rays of the spectrum.

If we now remove one atom of hydrogen from each of the two end carbon atoms of hexane, these atoms are in a condition to unite directly with each other, thus closing the chain. The substance so formed belongs to the cyclic division of organic compounds. It is known as cyclohexane, and has the formula C_6H_{12}, each carbon atom having two hydrogen atoms attached to it. This substance resembles hexane generally in its chemical properties, and behaves towards light in the same way, that is to say, it is practically diactinic or only cuts off some of the rays of light at the extreme ultra-violet end of the spectrum.

But a wholly different condition is brought about if we suppose one atom of hydrogen removed from each of the six carbon atoms of cyclohexane. One linkage is thus set free in each of the six carbon atoms, and we obtain benzene. How these linkages are actually employed in benzene has never been determined with certainty. Sometimes they are represented as mutually neutralising one another, sometimes as effecting a double link between the alternate pairs of carbon atoms. However this may be, the structure which bears the relation that I have indicated to the structure of hexane and cyclohexane is characteristic of the large group of organic substances of which benzene is the type. It is to this division of the cyclic compounds that the great majority of substances which show selective absorption, *i.e.* produce breaks or dark bands in the spectrum, belong. Here, then, we have a very important and a very general relation between the structure of organic substances and their absorption spectra.

The difference in the behaviour of organic bodies towards the ultra-violet rays, as exemplified in hexane and cyclohexane, on one hand, and benzene on the other, is brought out very clearly when we examine some of their derivatives. If we replace an atom of hydrogen in hexane or cyclohexane by the monovalent group hydroxyl, we get substances belonging to the class of alcohols, and these substances are, like their parent substances, highly diactinic. If, on the other hand, we replace an atom of hydrogen in benzene by the same group we get carbolic acid or phenol, which, like benzene, exercises selective absorption on the ultra-violet rays, but gives a spectrum widely different from that of benzene.

Having dealt with the most general relation that has been observed between the structure of organic substances and their action on the ultra-violet rays, I propose to illustrate some of the more special relations by examples from the phenomena of isomerism. By replacing an atom of hydrogen in carbolic acid or phenol by the nitro-group we obtain three distinct nitrophenols. The ultimate particles or molecules of these nitrophenols are all composed of the same elements—carbon, hydrogen, oxygen, and nitrogen—and of the same number of atoms of each element. Such substances are said to be isomeric, *i.e.* they are made up of equal parts, although they do not possess the same properties. The difference between them lies in the arrangement of the parts relatively to each other; in this case in the position of the nitro-group in relation to the hydroxyl group. On comparing the spectra of the three nitrophenols we find that they differ in quite a marked manner from one another, and afford an illustration of the important general rule that substances which have the same composition but different spectra differ in structure.

It will have been noticed that the substitution of the nitro-group for hydrogen in phenol has the effect of shifting the absorption band nearer to the visible region. One of the three nitrophenols has a yellow colour, and in this case the gap in the spectrum cuts a little way into the violet end of the visible region. By the addition of soda to the solution the colour is changed to red, and on examining the spectrum of this solution we see that the gap now extends far into the visible region. This example will serve to illustrate the close connection that exists between the

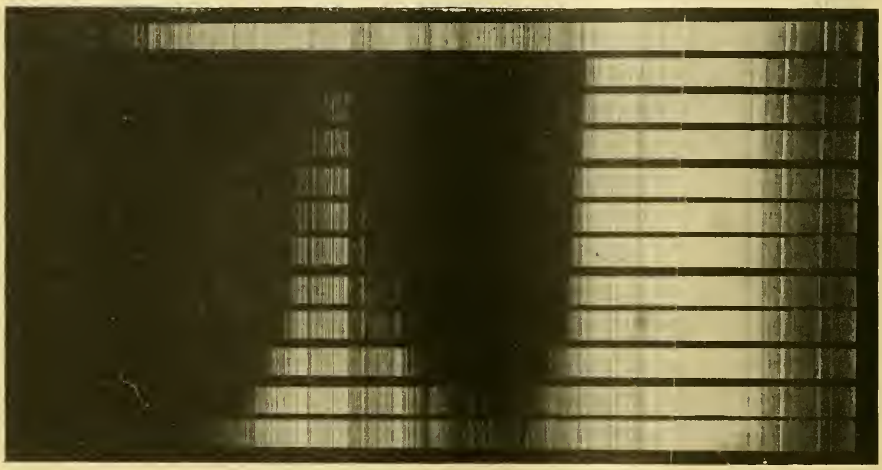

Fig. 3.—1. Spark spectrum of nickel and iron. 2 to 12. The same after light has passed through layers of 0·001 normal solution of salicylic acid from 90 to 4 mm. thick.

study of absorption spectra and the origin of colour, an interesting branch of the subject with which, however, it is impossible for me to deal within the limits of this discourse.

In the nitrophenols we have an example of what is known as structural isomerism, or position isomerism, because the phenomenon depends upon differences in the position or arrangement of the atoms within the molecule—in other words, in the internal structure of the molecule. But it is possible to have two substances of the same composition and structure not identical, but related to one another as an object is to its mirror-image. Substances so related are termed optical-isomers or stereo-isomers. The spectra of isomers of this class, unlike those of structural isomers, do not differ. This leads to an important application of absorption spectra in chemical investigations. If two substances have the same composition but different spectra, we know that they must be structurally different; if, on the other hand, they have the same composition and the same spectra, and yet are not identical, there is a strong probability although not a certainty, that they are optical-isomers.

The study of absorption spectra has proved of special value in the investigation of substances capable of existing in two forms which may pass the one into the other. It is rarely the case that both forms of such substances are stable, and it is often extremely difficult, or altogether impossible, on account of this instability, to determine by the ordinary chemical processes which of the two possible forms the substance as we know it possesses. Such substances, however, frequently give rise to two series of stable isomeric methyl- or ethyl-derivatives, the structure of which can be ascertained by chemical investigation. The parent substance, if not a mixture of the two forms, must correspond in structure with one or other of these derivatives, because it is a well-established fact that the introduction of the methyl- or ethyl-group into a substance in place of an atom of hydrogen does not appreciably alter the spectrum.

An example of this is afforded by the three substances isatin, methyl-isatin, and methyl-pseudo-isatin. The structure of methyl-isatin and of methyl-pseudo-isatin has been determined by chemical methods, but the structure of the parent substance isatin cannot be determined in this way. Is it constituted like methyl-isatin or like methyl-pseudo-isatin? Inspection of the photographs of the spectra of the three substances shows that while there is a wide difference between the spectra of isatin and methyl-isatin, the spectra of isatin and methyl-pseudo-isatin are almost identical, as we should expect them to be on the view that they are constructed alike.

This phenomenon, which is known as tautomerism, is due to the fact that some substances contain an atom of hydrogen, or it may be a hydroxyl group, which readily shifts its position within the molecule, leaving its union with one atom to attach itself to another. Another example of this is afforded by cotarnine, a substance found in opium. The molecule of cotarnine possesses an atom of carbon which is directly combined with an atom of nitrogen, and has also united to it a hydroxyl group. Under the influence of certain reagents the hydroxyl group leaves the carbon atom and attaches itself to the nitrogen atom, but can readily, by an alteration of the conditions, be enticed back again to the carbon atom. The shifting of the position of the hydroxyl group is accompanied by other changes which, however, it is not necessary that we should take into account for our present purpose. In this case both the tautomeric forms are, under certain conditions, stable. The form in which the hydroxyl is attached to the carbon is colourless, while the form in which it is attached to the nitrogen is yellow. The two forms have totally distinct absorption spectra. When one of the forms passes into the other under the influence of the appropriate reagent, the amount of change is proportional to the quantity of reagent added. It is possible, therefore, by taking photographs after the addition of each successive quantity of reagent, to trace the progress of the change through all its phases, and to ascertain how much of each form is present at any time. This is done by comparison with a series of reference plates prepared by photographing mixtures

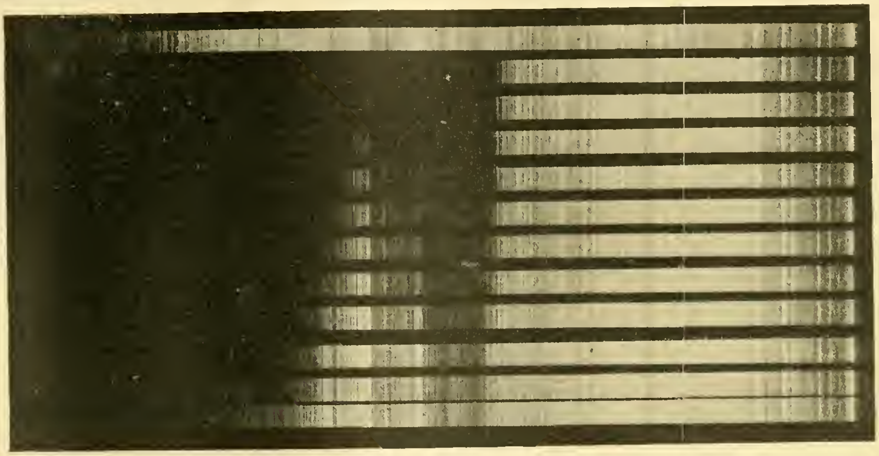

FIG. 4.—1. Spark spectrum of nickel and iron. 2 to 12. The same after the light has passed through layers from 60 to 4 mm. thick of an alcoholic solution of morphine containing $\frac{1}{200}$ grain of the alkaloid.

in various definite proportions of two derivatives of cotarnine which possess the same spectra as the two parent forms.

The study of the absorption spectra of the alkaloids has been applied with success, not only to the investigation of their structure but to their detection and estimation. These substances generally have very characteristic spectra by means of which they can be distinguished with certainty from one another, except when they are homologous or otherwise very closely related structurally. The spectroscopic method may, therefore, be used with great advantage in examinations for the presence of alkaloids to confirm the results obtained by the usual chemical tests. The chemical tests are no doubt as a rule sufficiently distinctive, but considering the gravity of the circumstances in which they have frequently to be applied, it is unnecessary to insist on the value of the confirmatory evidence which can be obtained by the use of the spectroscope.

The minutest quantities of alkaloids can be detected by this means, the method rivalling the colour reactions for the alkaloids in delicacy. Thus, with a quantity of strychnine not exceeding 1/500 of a grain, a clearly defined spectrum of the alkaloid can be obtained. The photograph of morphine already shown was obtained with 1/200 of a grain of the alkaloid, and that of nicotine with 1/100 (Fig. 4).

The use of the spectroscope in the detection and estimation of alkaloids in cases of poisoning possesses certain advantages of the highest importance. One is that the material is not destroyed. The solution which has been employed for the spectroscopic examination can be used afterwards for the chemical examination. Another is that a permanent record is obtained which is always available for reference.

So far my illustrations have been confined almost entirely to colourless substances, because it is in connection with the investigation of such substances that most of the recent advances in the subject have been made.

As my last example, I shall take the case of a coloured substance in which the method has been applied within the last year with marked success.

It will be remembered that considerable uneasiness was caused when it became known some time ago that nitrogen peroxide is sometimes employed to bleach flour. In the course of an inquiry into the subject, it became necessary to determine the nature of the colouring matter naturally present in flour. It was known that many of the yellow and orange pigments so widely distributed throughout the vegetable kingdom are either closely connected or identical with carrotene, the orange colouring matter of carrots, and it had been suggested that the colouring matter of unbleached flour might be identical with, or belong to the same class of colouring matters as, this substance. It was impossible, however, to prove this by the usual chemical methods, because the amount of colouring matter in flour is so minute that its isolation in a pure state, and in sufficient quantity for chemical analysis, was scarcely practicable. Carrotene, however, can be prepared in a pure state, and the happy idea occurred to Dr. Monier Williams, of the Local Government Board, who was conducting the investigation, to photograph its absorption spectrum and compare it with that of the colouring matter of flour, which could easily be obtained in the minute quantity required for this purpose. Inspection of the photographs shows that the spectra are very similar. There cannot, therefore, be any doubt that the colouring matter of flour, if not identical with, is closely allied to, carrotene.

The underlying causes of the relations between chemical structure and absorption spectra have been the subject of much speculation, but it must be confessed that no satisfactory explanation of the phenomena of absorption has yet been formulated, and that the theoretical development of the subject lags behind its practical application.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

ON the occasion of the installation of the Duke of Northumberland as Chancellor of Durham University on May 3, honorary degrees of the University were conferred on the following men of science :—*D.C.L.*, Lord Rayleigh; *D.Sc.*, Sir Archibald Geikie, K.C.B., P.R.S., Sir William Ramsay, K.C.B., Sir T. C. Allbutt, K.C.B., Sir J. A. Ewing, K.C.B., Sir William Crookes, O.M.; Sir J. J. Thomson, O.M., and Prof. E. B. Poulton.

IN the House of Commons on Monday, May 5, Mr. Asquith, replying to several questions referring to the recent decision of the Convocation of the University of Oxford as to Divinity degrees, said :—"I have for a long time had under consideration the various proposals for the appointment of a Royal Commission or Commissions to inquire into the constitution of, and other matters connected with, the Universities of Oxford and Cambridge. I have reluctantly come to the conclusion that in existing circumstances the setting up of such an inquiry might lead to delay in the prosecution of necessary reforms and is not likely to be productive of fruitful consequences."

THE first session of the new University of Western Australia was inaugurated on Monday, March 31, with an address on the place of mathematics and physics in a university education, by Prof. A. D. Ross. About 150 students have enrolled in the faculties of arts, science, engineering, and agriculture. At present the teaching is being carried on under considerable difficulties, as the portion of the temporary buildings which has already been erected does not afford accommodation for laboratory instruction. The work of extending the premises is, however, being pushed on rapidly, and the various science departments should be in a position to carry on their practical work in the third term.

THE April number of *The Eugenics Review* is mainly occupied with the report of the Eugenics Education Conference, which took place on March 1, and was reported in NATURE of March 6. As a practical outcome of the conference a deputation, having for its object the introduction of teaching of eugenics in training colleges, waited on Mr. Trevelyan, M.P., at the offices of the Board of Education on April 2. The deputation, which included, among others, the president of the Eugenics Education Society, the Dean of St. Paul's, the headmaster of Eton, the principal of Bedford College, and Mr. Nicholls, ex-president of the National Union of Teachers, was sympathetically received by Mr. Trevelyan, who said that the Board of Education recognised the importance of the matter referred to, and would consider carefully the recommendations made by the deputation. From the "Notes" column of the review we learn of the formation on January 29 of the Société Française d'Eugénique. The president of this society is M. Edmond Perrier, the general secretary M. le Dr. Apert, and the treasurer and librarian M. Lucien March. In Italy a eugenics society is in course of formation, and in Denmark, at the instigation of Dr. Soren Hansen, a eugenics section of the Anthropological Committee has been organised. The research committee of the Eugenics Education Society issues an appeal for help (not financial) in a cooperative research recently set on foot, particulars of which may be obtained on application to the chairman of the research committee, Eugenics Education Society, Kingsway House, Kingsway, London, W.C.

AT the annual meeting of the National Education Association, held on May 2, Lord Sheffield made some interesting comparisons between the educational systems of Scotland and England. Supplementary courses are recognised for all schools in Scotland, where, at the end of August, 1911, there were 2056 such courses in 3173 primary schools, and they had 49,497 pupils above twelve years of age in average attendance, out of a total of 783,792 pupils in average attendance. The grants to pupils in these courses amount to more than 4*l*. a head, while in England the grant is 2*l*. a head to pupils in elementary schools. In Scotland 6·3 per cent. of the pupils are under advanced instruction in ordinary schools, or about 30 per cent. of the pupils above twelve years of age in ordinary elementary schools. In England there are no such pupils and no such classes, but there were, in 1911–12, 1,032,000 pupils above twelve years. There are 194 higher grade schools in Scotland, with more than 24,000 pupils in average attendance, or 3·2 per cent. of all the pupils in elementary schools. In 1910–11 there were only forty-seven such schools in England and Wales, with 8852 pupils, or less than one-twentieth of the Scotch proportion. The grants for these schools in Scotland are 2*l*. 10*s*. a head for the first year, 3*l*. 10*s*. for the second year, 4*l*. 10*s*. for the third and further years, all capable of an increase of 10 per cent. for good work. The grants of the English code for higher elementary schools are: first year, 30*s*., second, 45*s*., third, 60*s*., or an average just above 2*l*. a head, and, with the fee grant and aid grant, a total of 3*l*. a head. The assimilation of the English higher elementary schools to the Scotch higher grade schools in all matters could be done by departmental action alone. The Scotch report for 1912–13 shows that more than 95 per cent. of the teachers are certificated, and 68 per cent. trained, and there is one certificated teacher to thirty-nine pupils. In England and Wales there is one certificated teacher to about fifty-two pupils, and in 1911–12 less than 65 per cent. were certificated. The average salaries of teachers certificated are, in Scotland in 1910–11, men, 138*l*., women, 83*l*.; in England, men, 127*l*., women, 92*l*. In Scotland the salaries work out at about 3*l*. per pupil, and in England and Wales at about 2*l*. 17*s*. 4*d*. per pupil. The total cost of board schools in Scotland for school maintenance and interest and repayment of loans is about 4*l*. 16*s*. In England it is between 4*l*. 8*s*. and 4*l*. 10*s*.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 1.—Sir Archibald Geikie, K.C.B., president in the chair.—Prof. E. H. **Griffiths** and Ezer **Griffiths**: The capacity for heat of metals at different temperatures. The thermal capacity, at various temperatures between 0° and 100°, of the following metals has been determined:—Cu, Al, Fe, Zn, Ag, Cd, Sn, and Pb. The work at lower temperatures will be published later. The variation in the thermal capacity can be represented (over the range 0° to 100°) by the following parabolic equations, the difference between the calculated and experimental values in no case exceeding 0·2 per cent. In the large majority of cases the difference is less than 0·1 per cent.

Cu	$s=0{\cdot}09088\ (1+0{\cdot}0005341t-0{\cdot}00000048t^2)$,
Al	$s=0{\cdot}20957\ (1+0{\cdot}0009161t-0{\cdot}0000017t^2)$,
Fe (ingot)	$s=0{\cdot}10452\ (1+0{\cdot}001520t-0{\cdot}00000617t^2)$,
Zn	$s=0{\cdot}09176\ (1+0{\cdot}0005605t-0{\cdot}00000178t^2)$,
Ag	$s=0{\cdot}05560\ (1+0{\cdot}0003396t-0{\cdot}000000141t^2)$,
Cd	$s=0{\cdot}05475\ (1+0{\cdot}000520t-0{\cdot}000000725t^2)$,
Sn	$s=0{\cdot}05363\ (1+0{\cdot}0006704t-0{\cdot}000000458t^2)$,
Pb	$s=0{\cdot}030196(1+0{\cdot}000400t-0{\cdot}00000036t^2)$,

Many forms of equations were tried, but it was found that the experimental results were more closely represented by the parabolic than by any other form.—A. **Robertson** and G. **Cook**: The transition from the elastic to the plastic state in mild steel. The paper deals with the reduction of stress at the yield point in mild steel. Apparatus for limiting the extension during yield to a value comparable with the elastic extension, and for securing axial loading, are described. Under these conditions twelve specimens were tested, and a reduction of stress of 24 to 36 per cent. observed in eleven, and of 17 per cent. in the other one.—F. P. **Worley**: Studies of the processes operative in solutions. XXVIII., The influence of acids on the rotatory power of cane-sugar, of glucose, and of fructose. Experiments on the hydrolysis of cane-sugar by solutions of benzene-sulphonic acid have confirmed the conclusion previously arrived at from those in which sulphuric acid was used, that the ratio of the negative optical rotation at the completion of hydrolysis to the initial positive rotation increases rapidly as the concentration of the acid is increased. The increase is proportional to the concentration of the acid, and in the case of benzenesulphonic acid amounts to about 20 per cent. when the concentration is increased from zero to twice normal. It has been found that the increase is due entirely to the influence of the acid on the rotatory power of the three sugars, cane-sugar and glucose being made somewhat less dextro-rotatory and lævulose considerably more lævo-rotatory by the presence of the acid.—H. G. J. **Moseley**: The attainment of high potentials by the use of radium. A radio-active substance which emits β-radiation should, when insulated, continue to gain a positive charge until a potential of the order of a million volts is reached. Experiments have been made to test this point. A small bulb containing radium emanation was supported by a quartz rod at the centre of a highly exhausted flask. A disc suspended from a quartz spring in the neck of the flask formed a simple attracted disc electrometer. It was found that a bulb of 9 mm. diameter reached a potential of 160,000 volts in the course of a few minutes. A sudden discharge then occurred through the residual gas in the flask. A bulb of 5 cm. diameter charged up much more slowly: no discharge took place, and the final potential, 110,000 volts, was limited by a leak of electricity along the quartz support.—E. **Marsden** and Dr. T. S. **Taylor**: The decrease in velocity of α particles in passing through matter. The relative velocities of the α particles of radium C before and after passing through foils of various thicknesses have been investigated by means of the deflection caused by a magnetic field. Tables are given showing the results for gold, copper, aluminium, mica, and air.

Linnean Society, April 17. Prof. E. B. Poulton, F.R.S., president, in the chair.—M. P. **Price** and N. D. **Simpson**: Plants collected on the Carruthers-Miller-Price expedition through north-west Mongolia and Chinese Dzungaria.—E. G. **Baker**: Some British varieties of the bee-orchis, *Ophrys apifera*, Huds. In the typical form of the bee-orchis the labellum is broad convex, with a terminal, reflexed appendage, brown-purple, disc spotted with orange-yellow. In 1840 Hegetschweiler, in "Die Flora der Schweiz," described and figured *Ophrys Trollii,* a plant with the middle lobe of the labellum narrow lanceolate, elongated, purplish-red in the centre, gold at the edge, the three outer perianth-lobes lanceolate pointed. The plant came from Winterthur. In this country there appears to be a series of intermediate forms connecting the typical form with *O. Trollii,* some being more nearly allied to the former, some to the latter.—Dr. Hisayoshi **Takeda**: The flora of Shikotan. Shikotan is the southernmost of the Kurile Islands, which are distributed in the form of a chain between Kamtschatka and Yezo, and lies between about 43° 35′ and 50′ N. and 146° 30′ and 55′ E. Its area does not perhaps exceed 140 sq. m. The island is hilly, and some of the hills are covered with forests of conifers and deciduous trees, others with dwarf bamboos—species of Sasa. There are many streams along which bogs and swamps are often well developed. The vegetation of this island has scarcely been touched by human hands, but left in quite a primitive state. The number of the higher plants known to the author is 324, belonging to 213 genera and sixty-two families, of which 245, including eight new species, are new to the flora of this island, while 136 species are not mentioned in Miyabe's "Flora of the Kurile Islands," published in 1890, and also fifty-eight genera and eight families are additions to that publication. Among plants which are common to Shikotan (and also other islands of the Kuriles) and Yezo, or Yezo and Hondo, but not found in Saghalien, there are a number of plants which are distributed over north-eastern Asia, the Aleutian Islands, &c. These plants are believed by the author to have been introduced through the Kurile chain, but not through Saghalien.

Zoological Society, April 22.—Mr. E. T. Newton, F.R.S., in the chair.—Dr. S. F. **Harmer**: The polyzoa of waterworks. An account was given of the serious trouble which had been caused by the occurrence of a rich and varied fauna in the pipes of certain foreign waterworks, notably at Hamburg and Rotterdam. As was first shown by Kraepelin, the polyzoa play a prominent part in the activity of the pipe-fauna, by feeding on diatoms and other microscopic organisms, and serving in their turn as the food of other animals which prey on one another. The nutritive matter rendered available by the presence of enormous numbers of polyzoa is thus in large measure responsible for the existence of other constituents of the fauna, which may include even fishes, such as the eel and the stickleback. The organic material supplied by the disintegration of the polyzoa and other animals is believed to be important for the nutrition of iron-bacteria, which are well known to cause the most serious trouble in waterworks. An account was given of five cases of the occurrence of polyzoa in English waterworks in sufficient numbers to give rise to very serious inconvenience. In one or two of these cases the advice given by Kraepelin, in his paper on the Hamburg pipe-fauna, was being followed, by the introduction of a system of filtration, the principal object of which is to remove the microscopic organisms on which the polyzoa, and ultimately the whole assemblage of animals in the pipes, depend for their nutriment.—A. W. **Waters**: The marine fauna of British East Africa and Zanzibar, from collections made by Cyril Crossland, in the years 1901–2. Bryozoa—Cheilostomata. In the collection dealt with from the neighbourhood of Zanzibar there are seventy-six species or varieties of cheilostomatous bryozoa, almost all being from ten fathoms or under, so that for a shallow-water collection it is very large.—Major J. **Stevenson-Hamilton**: Occurrence of albino examples of the reed-buck (*Cervicapra arundinum*) in the Sabi Reserve, Transvaal. Some interesting notes were also given on the habits and distribution of Sharpe's steenbuck (*Raphiceros sharpei*), which resembles the grysbok much more closely than it resembles the common steenbuck in mode of life, and ranges from Nyasaland to the Transvaal, but gradually dies out to the south-east of that country.

Geological Society, April 23.—Dr. Aubrey Strahan, president, in the chair.—R. H. **Goode**: The fossil flora of the Pembrokeshire portion of the South Wales Coalfield. Of the fifty-three determinable species of fossil plants obtained from the Pembrokeshire portion of the South Wales Coalfield, three are new species. From the palæobotanical evidence it is clear that the so-called "Pennant Grit" of Pembrokeshire cannot be regarded as the equivalent of the Pennant Grit of the main portion of the South Wales Coalfield. Until more plants have been obtained from the so-called "Millstone Grit" of Pembrokeshire, it is impossible to fix definitely the horizon of these beds. However, it is evident that the beds assigned to the Millstone Grit probably belong to the Middle Coal Measures. Thirty-two fossil plants have been obtained from the Middle Coal Measures of Pembrokeshire which have not as yet been recorded from those of the main South Wales Coalfield.—H. **Kay**: The Halesowen Sandstone Series of the southern end of the South Staffordshire Coalfield, and the petrified logs of wood found therein at Witley Colliery, Halesowen (Worcestershire). With an appendix on the structure of a new species of Dadoxylon, by E. A. Newell **Arber**. The Halesowen coal-seam and associated beds of blue clay form a definite intermediate horizon traceable across the coalfield. The area is folded into two anticlines with a deep central syncline ranging south-south-eastwards, and the strata have a south-south-easterly dip. The northern face is let down by a fault repeating the lower beds. Other faults throw southwards, and yet others intersect the anticlines. Mining operations show the existence of a buried anticline with the full Coal-Measure Series. The Witley Colliery railway-cutting shows big logs of petrified wood finely preserved by calcite, and of Upper Carboniferous age. The wood has been examined by Dr. Newell Arber, who finds it to have Araucarian affinities, but of a species new to science. In consequence of its Palæozoic age, it is referred to the genus Dadoxylon. The type of preservation is also new to this horizon in this country, and the discovery of Dadoxylon at Witley constitutes a new record for British Upper Carboniferous rocks.

MANCHESTER.

Literary and Philosophical Society, March 18.—Prof. F. E. Weiss, president, in the chair.—W. H. **Sutcliffe**: A criticism of some modern tendencies in prehistoric anthropology. During the last few years there has been a great revival of interest in the study of Palæolithic man and his instruments in Britain, some of which are of great importance on account of the care and skill with which they have been worked, whilst others appear to be founded on untrustworthy evidence. The author discussed such of these latter as lead to the necessity of demanding a pre-Pleistocene arrival of man in Britain. The Kent plateau eoliths were examined and compared with the chipped flints found by Mr. V. Commont and l'Abbé H. Breuil in the Thanetian beds of north France and those described by Mr. Hazzledine Warren from the undisturbed "clay with flints." It was pointed out that, from our extensive knowledge of the fauna of this formation (Rheims and New Mexico), it is quite certain that no tool-using animal could possibly have been present at this remote time, and that therefore these flints, some of which closely resemble well-made implements, must be of purely natural origin. The "rostro-carinate" flints described by Sir E. Ray Lankester from the Red Crag were next examined, and it was shown that the same type occurs in the ordinary Palæolithic gravel of Hackney Downs. Lankester has also found the same type in the Middle Miocene of Aurillac. It is inconceivable that a human production should have retained exactly the same form throughout this immense period considering the rapidity of evolution of type shown among Palæolithic implements. The "rostro-carinate" flints were found to be not adapted to any likely use, and the conclusion is reached that they cannot be held to give good evidence of the existence of Pliocene man. On examining the age of the Galley Hill and Ipswich skeletons, the extreme improbability of the only two known human remains found in gravel (prior to the recent discovery of the Sussex man) each being a complete skeleton, in view of the very great rarity of even small associated sets of bones of other mammals in the same and similar gravels, was dwelt upon. The Galley Hill skeleton's authenticity depends on the evidence of two witnesses with no geological training, who contradict one another on so fundamental a fact as the nature of the bed in which it lay—one called it mould, the other gravel. As regards the Ipswich man, the author pointed out the impossibility of a human skeleton lying closely contracted on a surface of loose sand resisting the action of a glacier which is supposed to have deposited Boulder Clay over it. The conclusion was reached that both skeletons are merely burials of quite comparatively recent date.

April 8.—Prof. F. E. Weiss, president, in the chair.—W. **Burton**: Note on black pottery from Ashanti and the Gold Coast.—W. **Thomson**: The influence of moisture in the air on metabolism in the body. The author had previously pointed out that metabolism in the lungs (as indicated by the percentage of carbonic acid gas in the exhaled air) took place to a greater extent when breathing dry than when breathing damp air. He now tested this further on the effect of the various alterations in the atmosphere, viz. the combined influence of pressure, temperature, and hygroscopic state of the atmosphere on the carbonic acid gas contained in the exhaled air from the lungs. His experiments showed that some people are more sensitive than others to dry or damp air, but the general result showed that the difference of the carbonic acid gas in the exhaled air, when breathing cold damp air, amounted to about 4 per cent. increase when breathing cold dry air, whilst with warm air the difference showed an increase for the warm dry air of 7·53 per cent.

April 22.—Prof. F. E. Weiss, president, in the chair.—Prof. F. E. **Weiss**: A Tylodendron-like fossil. While agreeing in general external appearance and also to some extent in the structure of the remains of the woody tissues found outside the pith, the latter was remarkable for the considerable development of secretory canals in its thin-walled tissue. The presence of these and other considerations led the author to the conclusion that the pith was more likely to have belonged to a plant of Cycadian than to one of Araucarian affinity.—W. **Robinson**: Some relations between *Puccinia malvacearum*, Mont., and the tissues of its host. The general features of the pustules as shown on petiole, stem, and leaves of the hollyhock (*Althaea rosea*) were described. The relations of the distribution of the fungal mycelium to the starch content of the host were pointed out, and the relations between the haustoria and the individual cells were dealt with. By a series of plasmolysis experiments the haustoria were demonstrated to enter cells which remained living after entry, and they were shown to lie within the protoplasm and to grow towards the nucleus. The results indicate a slow tapping of the resources of living cells by the haustoria, which are able to penetrate the protoplasm in such a way that the cells remain alive for a considerable time.

BOOKS RECEIVED.

Bergens Museum. Aarsberetning for 1912. Pp. 119. (Bergen: J. Griegs Boktrykkeri.)

Uebungsbeispiele aus der unorganischen Experimentalchemie. By H. and W. Biltz. Zweite Auflage. Pp. xi+237. (Leipzig: W. Engelmann.) 8 marks.

Ministry of Finance, Egypt. Survey Department Report on the Work of the Survey Department in 1911. Pp. 76. (Cairo: Government Press.) 10 P.T.

General Index to *The Chemical News*. Vols. i. to c. Pp. iii+712. (London: *Chemical News* Office.) 2*l*.

The People's Books:—The Science of Light. By Dr. P. Phillips. Pp. 92. Gardening. By A. C. Bartlett. Pp. 94. British Birds. By F. B. Kirkman. Pp. iv+96. (London and Edinburgh: T. C. and E. C. Jack.) 6*d*. each.

Malaria, Cause and Control. By Prof. W. B. Herms. Pp. xi+163. (London: Macmillan and Co., Ltd.) 6*s*. 6*d*. net.

Problems in Eugenics. Vol. ii. Report of Proceedings in the First International Eugenics Congress, held at the University of London, July 24 to 30, 1912, together with an Appendix containing those Papers communicated to the Congress not included in vol. i. Pp. 189+index. (London: Eugenics Education Society.)

La Matière. Sa Vie et ses Transformations. By Prof. L. Houllevigue. Pp. xxxii+319. (Paris: A. Colin.) 3.50 francs.

Fortschritte der Mineralogie, Kristallographie, und Petrographie. Edited by Dr. G. Linck. Dritter Band. Pp. 320. (Jena: G. Fischer.) 10 marks.

Manual of Wireless Telegraphy and Telephony. By A. F. Collins. Third edition. Pp. xv+300. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 6*s*. 6*d*. net.

The Theory and Practice of Working Plans (Forest Organisation). By Prof. A. B. Recknagel. Pp. xii+235+vi plates. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

Schnee und Eis der Erde. By Prof. H. Wieleitner. Pp. 198+xvi plates. (Leipzig: P. Reclamm, jun.) 1 mark.

Bogen und Pfeil bei den Volkern des Altertums. By E. Bulanda. Pp. vi+136. (Vienna and Leipzig: A. Hölder.) 6.80 marks.

Gouvernement Egyptien. Administration des Arpentages. Catalogue des Invertébrés Fossiles de l'Egypte représentés dans les Collections du Geological Museum au Caire. By R. Fourtau. Pp. 93+vi plates. (Le Caire: Imprimerie Nationale.) 40 P.T.

Religious Beliefs of Scientists. By A. H. Tabrum. New edition. Pp. xxi+309. (London: Hunter and Longhurst.) 2*s*. 6*d*. net.

A Synopsis of the Classification of Insects. By Prof. H. M. Lefroy. Pp. 32. (London: Lamley and Co.) 1*s*. net.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. Lief. 32–33. (Jena: G. Fischer.) 5 marks each Lief.

Vorlesungen über allgemeine Histologie. By Prof. A. Gurwitsch. Pp. v+345. (Jena: G. Fischer.) 11 marks.

Photographic Supplement to Stanford's Geological Atlas of Great Britain and Ireland. Arranged and edited by H. B. Woodward, with the cooperation of Miss H. D. Sharpe. Pp. 113. (London: E. Stanford, Ltd.) 4*s*. net.

Die europaeischen Schlangen. By Dr. F. Steinheil. Erstes Heft. 5 plates. (Jena: G. Fischer.) 3 marks.

Memoirs of the Peabody Museum of American Archæology and Ethnology, Harvard University. Vol. vi., A Study of Maya Art: its Subject Matter and Historical Development. By H. J. Spinden. Pp. xxiii+285+29 plates+map. (Cambridge, Mass.: Peabody Museum.)

Monographs of the United States Geological Survey. Vol. li., Cambrian Brachiopoda. By C. D. Walcott. Part i. Text. Pp. 872. Part ii. Plates. Pp. 363+civ plates. (Washington: Government Printing Office.)

Thirty-third Annual Report of the Director of the United States Geological Survey to the Secretary of the Interior. For the Fiscal Year ended June 30, 1912. Pp. 175. (Washington: Government Printing Office.)

United States Geological Survey. Professional Paper 77. Geology and Ore Deposits of the Park City District, Utah. By J. M. Boutwell, with contributions by L. H. Woolsey. Pp. 231+xliv plates. (Washington: Government Printing Office.)

United States Bureau of Entomology. Bulletin No. 91. The Importation into the United States of the Parasites of the Gipsy Moth and the Brown-tail Moth. By L. O. Howard and W. F. Fiske. Pp. 344+xxviii plates. (Washington: Government Printing Office.)

Researches into Induced Cell-Reproduction and Cancer, and other Papers. Vol. iii. By H. C. Ross, J. W. Cropper, E. H. Ross, H. Bayon, W. J. A. Butterfield, E. Jennings, and S. R. Mowlgavkar. (The John Howard McFadden Researches.) Pp. 149. (London: John Murray.) 5*s*. net.

Physikalische Chemie der homogenen und heterogenen Gasreaktionen. By Dr. K. Jellinek. Pp. xiv+844. (Leipzig: S. Hirzel.) 30 marks.

Annual Report of the Board of Scientific Advice for India for the Year 1911–12. Pp. 201. (Calcutta: Superintendent Government Printing, India.) 1*s*. 6*d*.

A Dictionary of English and Folklore-Names of British Birds. By H. K. Swann. Pp. xii+266. (London: Witherby and Co.) 10*s*. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 8.

ROYAL SOCIETY, at 4.30.—The Various Inclinations of the Electrical Axis of the Human Heart: A. D. Waller.—Trypanosome Diseases of Domestic Animals in Nyasaland. III.: *Trypanosoma pecorum*: Surg.-Gen Sir D. Bruce, Major D. Harvey, Major A. E. Hamerton, and Lady Bruce.—The Excystation of *Colpoda cucullis* from its Resting Cysts and the Nature and Properties of the Cyst Membranes: T. Goodey.—The Experimental Hybridisation of Echinoids: C. Shearer, W. de Morgan, and H. M. Fuchs.

CONCRETE INSTITUTE, at 7.30.—Shear and Problems arising therefrom: H. K. Dyson.

FRIDAY, MAY 9.

ROYAL INSTITUTION, at 9.—Life History of a Water Beetle: F. B. Browne.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Polar Diameter of Saturn and the Minor Axis of the Ring: E. E. Barnard.—Note on the Pressure of Radiation on a Small Reflecting Sphere: J. Proudman.—An Investigation on the Motion of the Stars: C. V. L. Charlier.—The Mode of Propagation of the Sun's Influence in Magnetic Storms: Rev. A. L. Cortie.—The Motions and Distances of the Pleiades and other Groups of Stars: H. C. Plummer.—*Probable Papers*: A Regular Law representing Wolf's Sun-spot Numbers: H. H. Turner.—Preliminary Discussion of the Discordance between the Observed and Predicted Positions of Jupiter's Eighth Satellite: J. Jackson.—Photographic Determination of the Proper Motions of 250 Stars in the Neighbourhood of Σ443: A. A. Rambaut.

SATURDAY, MAY 10.

ROYAL INSTITUTION, at 3.—Humphrey Internal Combustion Pumps: H. A. Humphrey.

TUESDAY, MAY 13.

ROYAL INSTITUTION, at 3.—Recent Physiological Inquiries: (3) Ductless Glands and their Dominating Influence: Prof. W. Stirling.

FRIDAY, MAY 16.

ROYAL INSTITUTION, at 9.—The Pygmies of New Guinea: Captain C. G. Rawling.

PHYSICAL SOCIETY, at 8.—Some Experiments to Detect β-rays from Radium A.: Dr. W. Makower and Dr. S. Russ.—Dust Figures: Dr. J. Robinson.

SATURDAY, MAY 17.

ROYAL INSTITUTION, at 3.—Humphrey Internal Combustion Pumps: H. A. Humphrey.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2272, VOL. 91] THURSDAY, MAY 15, 1913 [PRICE SIXPENCE

Registered as a Newspaper at the General Post Office.]

THURSDAY, MAY 15, 1913.

A NEW TEXT-BOOK OF PHYSIOLOGY.

Principles of Human Physiology. By Prof. E. H. Starling, F.R.S. Pp. xii + 1423. (London: J. and A. Churchill, 1912.) Price 21s. net.

TO one familiar with modern text-books of human physiology, the title of this work suggests something out of the common run. Excellent "elements" of the subject, "manuals," and "text-books" exist in plenty. Indeed, English-speaking students are exceptionally fortunate in possessing as they do such a selection of trustworthy and often attractive presentations of the established facts of the science. At the same time many teachers have undoubtedly felt that the existing students' text-book, admirable as it is, is not in all things in tune with the times, and that a new presentation in which more attention should be paid to recently revealed or recently applied "principles" would be a welcome acquisition. Prof. Starling's work is a response to this commonly-felt *desiderium*.

To attempt to combine an up-to-date exposition of the traditional subject-matter of a manual of human physiology with a sufficiently well-informed *résumé* of new and unfamiliar but appropriate branches of chemistry and physics, showing wherever available the connection between the one and the other, and in addition indicating the general trend of modern physiological investigation, implies qualifications rarely met with in one individual. It will be generally conceded that no one, whether from versatility of personal experience or from environment, was more competent than Prof. Starling to undertake the task. It will be equally conceded that his reputation has not suffered in the achievement. In more respects than one the book represents an advance on previous works of a similar kind.

A word as to its history. Some fifteen or twenty years ago there existed an unpretentious little volume by the author entitled "Elements of Human Physiology." Admirably concise, clear in thought and style, no better epitome of physiology could be put in the hands of a student. The author subsequently enlarged this book, leaving the title unchanged. Although the enlargement went through a number of editions, it was never such an unqualified success as the original, at least from the reader's point of view. Like the new dress of the little girl who had made up her mind to cry, it was "either too long or too short." The present volume represents a further transformation, in which the whole work has been recast and greatly expanded, and the title changed. At the same time it carries within it unmistakable and almost ineffaceable traces of its predecessors.

An important feature of the book is the insertion of an introductory section on general physiology. This consists for the most part of two substantial chapters, one on the chemistry of cells and food materials, the other on elementary physical chemistry so far as it bears on physiology. The latter is a welcome innovation, for it provides essential information that can otherwise be obtained only with difficulty. The bulk of the volume is devoted to the stock subject-matter of a text-book of physiology, the material being grouped under two main headings, "The Mechanisms of Movement and Sensation" and "The Mechanisms of Nutrition." The author's first-hand experimental knowledge is especially brought out in the latter of these, while the former is mainly notable for the incorporation of Sherrington's work on the central nervous system. The book ends with a short section on reproduction. Apparently the author has not considered the time ripe for the introduction of a special section on growth. The book is illustrated with a wealth of pictorial matter, chiefly in the form of diagrams.

While the work as a whole bears evidence of strenuous effort to bring it up to date (it contains a large amount of material comprised in no other general text-book of physiology), the process of modernisation is unequal. Thus, the value of the chapters on muscle and nerve has been enhanced by the inclusion of much recent investigation, especially of workers in the Cambridge school, but the partial selection of this material and the omission of other recent Continental work indicate that the author has failed to grasp some of the most suggestive teachings of nerve and muscle experiment. Again, the chapter on coagulation of the blood contains an admirable history of the coagulation question almost up to the date of publication, but the account of blood-platelets, with which coagulation is so intimately associated, is not only inadequate, but in regard to many statements quite misleading.

The omission of any single section on the liver is difficult to explain. While a considerable amount of information (not always correctly indexed) on the physiology of the organ is scattered throughout the book, the structure and vascular relations of the liver are not described.

One greatly regrets that the author has not seen his way to provide occasional references to original papers. A good scientific text-book has two classes of readers, students and research workers. To the latter a handy reference is most acceptable. For students the systematic mention of names and *dates* (the latter word might be written in capital letters) is an indispensable part of the apparatus of scientific education. On glancing over those names that are incorporated in the body of the text or attached to important illustrations, one cannot but remark how very English the experimental side of physiology has become.

Breadth of outlook, to which the author lays some claim in his preface, has been secured not in every case by new and suggestive presentation of the materials to hand. Often enough, the author has depended rather on weight of added fact to illumine the intelligence of his readers. The consequence is that while he possesses a clear style that states scientific fact and argument without prolixity or ambiguity, his book makes at the best hard reading, its perusal being calculated to inspire respect rather than enthusiasm for the subject. Its obvious merits, however, outweigh all its defects.

Textual errors and other discrepancies are present in not too great abundance. While no serious blunder of this kind has caught the eye of the reviewer, he *would* venture to protest against the retention of the Egyptian-like perspective of fig. 60.

BRITISH BOTANISTS.

Makers of British Botany: a Collection of Biographies by Living Botanists. Edited by F. W. Oliver. Pp. iv + 332 + xxvi plates. (Cambridge University Press, 1913.) Price 9s. net.

THE decision to publish the course of lectures on British botanists given at London University in 1911 was a very wise one, and Prof. F. W. Oliver deserves our sincere thanks for the trouble he has taken to produce so excellent a result. The volume is full of interest, and contains much concerning the lives and activities of some of the lesser-known British botanists that might otherwise have passed into oblivion.

Modern botanists, after the perusal of the several biographies, may well reflect not only when they consider the remarkable energy of their distinguished predecessors, but also when they realise, as they now can, how great were the advances made in botanical science, despite innumerable difficulties, by the pioneers of the subject.

The ten lectures of the course deal with the work of the following botanists: (1) Morrison (1620–83) and Ray (1627–1705); (2) Grew (1641–1712); (3) Hales (1677–1761); (4) Brown (1773–1858); (5) Sir W. Hooker (1785–1865); (6) Henslow (1796–1861); (7) W. Griffith (1810–45); (8) Henfrey (1819–59); (9) Harvey (1811–66); and (10) Williamson (1816–95).

Since these biographies did not, of course, include all the distinguished botanists to whose labours we owe the foundation of botanical science in this country, it was wisely decided to supplement the lectures by the inclusion of chapters dealing with certain other botanists equally deserving of recognition as founders of the science. Even with the inclusion of these worthies, namely, Hill (1716–75), Lindley (1799–1865), Berkeley (1803–89), Gilbert (1817–1901), Marshall Ward (1854–1905), the Edinburgh professors (1670–1887), and especially J. H. Balfour and Sir Joseph Hooker (1817–1911), the list is incomplete. Bentham, for instance, is an unfortunate omission, and it is to be hoped that it may not be long before a second edition is called for and that Prof. Oliver may carry out his intention of adding accounts of several other British botanists who should never be excluded from a historical account of botany in Britain.

Where the general level is so high, it is perhaps invidious to single out individual essays for special commendation, but of the lectures, Hales by Sir Francis Darwin and the account of Robert Brown by Prof. Farmer are of particular interest. The value of the volume is also very much enhanced by Sir W. T. Thiselton-Dyer's masterly account of Marshall Ward and by Prof. Bower's life of Sir Joseph Hooker, a task from its magnitude perhaps harder than that which fell to any other contributor to the volume.

One of the chief reasons why we are grateful for this book is not so much that it tells us once more about men whose names are as household words, but rather because the value of the work done by those whose contributions to the science have been known only to the few can now be seen in its true light by all. Until the appearance of the book, how few of the younger botanists could have given a coherent account of the work of William Griffith, Henfrey, or Harvey?

Griffith, as Prof. Lang points out, was a great botanist:

"It is true that he failed to break through the limitations of his time and period, that he left no new and more correct general views to modify the science. But this is true of all his contemporaries; indeed, it is true of most botanists. To recreate the department of a science in which a man labours requires a combination of ability and fortunate chances that is given to few."

It is especially fitting to remember Griffith at the present day since he was a pioneer in the line of botanical work now known as ecology. Not only did he collect plants, but he frequently adopted the "plan of roughly mapping each day's route and indicating the plants and associations of plants along the line of march." Ecological methods, it should be remembered, were also prominent in the teaching of John Hutton Balfour.

Many passages of particular interest might be quoted from all of the chapters, but as the book to be appreciated must be read as a whole, we would rather commend it warmly to students of natural history and to those who would know of Britain's worthies. Thanks to the diaries kept by our earliest botanists and from the free use of contemporary information, the biographies are full of living personal interest. We can picture Robert Brown—facile botanicorum princeps, Britanniæ gloria et ornamentum—all the more easily and truly from the human touches in the following extracts from his diary for two consecutive days:

"Feb. 7.—Before breakfast began the German auxiliary verbs. . . . At dinner about 3 pints of port . . . slept in my chair till nearly 3 in the morning.

"Feb. 8.—Before breakfast finished the auxiliary verb *Seyn*; to be. . . ." A. W. H.

PRACTICAL AND THEORETICAL PHYSICS.

(1) *The Essentials of Physics.* By Prof. G. A. Hill. Pp. viii+346. (New York and London: Ginn and Co., n.d.) Price 5*s*.

(2) *Practical Measurements in Radio activity.* By Dr. W. Makower and Dr. H. Geiger. Pp ix+151. (London: Longmans, Green and Co., 1912.) Price 5*s*. net.

(3) *A Systematic Course of Practical Science for Secondary and other Schools.* By A. W. Mason. Book I., Introductory Physical Measurements. Pp. vii+126. (London: Rivingtons, 1912.) Price 1*s*. 6*d*. net.

(4) *Practical Physics: a Text-book for Technical Schools and Colleges.* By Angus McLean. Pp. xi+402. (London: Adam and Charles Black, 1912.) Price 7*s*. 6*d*. net.

(5) *A Course of Elementary Practical Physics.* By H. V. S. Shorter. Part i., Mensuration, Mechanics, Hydrostatics. Pp. 111. Price 2*s*. Part ii., Heat and Light. Pp. 216. Price 3*s*. (Oxford: Clarendon Press, 1912.)

(6) *Lehrbuch der Physik für Mediziner und Biologen.* By Dr. Ernst Lecher. Pp. vii+451. (Leipzig and Berlin: B. G. Teubner, 1912.) Price 8 marks.

(7) *An Introduction to Mathematical Physics.* By Dr. R. A. Houstoun. Pp. ix+199. (London: Longmans, Green and Co., 1912.) Price 6*s*. net.

(8) *Die Elektrizität.* By Prof. F. Adami. (Bücher der Naturwissenschaft, herausgegeben von Prof. S. Günther.) 9 und 14 Band. Pp. 126+4 plates+180+12 plates. (Leipzig: Philipp Reclam, jun., n.d.) Price 1.50 marks.

(1) OPINIONS differ as to the best mode of commencing instruction in every branch of knowledge. The correct solution of the problem is of much importance, particularly in physics, in which subject, for some reason, students seem to find more than average difficulty. The author of this book has been convinced by his teaching experience that the most efficient method of presenting the elementary principles is by means of question and answer. His book therefore consists entirely of a long series of questions. To the more difficult of these questions answers are appended; to the easier the student is expected to supply his own answers. The subjects treated are just those usual in an elementary text-book, the greatest stress, however, being laid on mechanics, to which about half the book is devoted.

While not questioning the undoubted value of question and answer in ascertaining the progress of students, it cannot be admitted that these form the function of a text-book. Question and answer should preferably be oral; they should also be mutual as between teacher and student. As a text-book the present volume is comparatively useless, principally on account of the lack of continuity and logical order which the method of presentation involves, but as a book of examples it may prove of considerable value.

(2) The appearance of a book on radio-active measurements is very welcome. That it should come from the laboratory of Prof. Rutherford, and have for its authors two such distinguished workers on radio-activity, practically ensures its general adoption in advanced physical laboratories. It can scarcely be doubted that the authors' assurance that so many and varied exercises in radio-activity can be performed with comparatively small quantities of active material will lead to the introduction of such measurements into the laboratory courses of many honours schools in physics. Most of the experiments described are already so included in Manchester, particularly with the view of the students ultimately taking up original research in this subject.

The earlier part of the book is devoted to the theory and practical use of the electrometer and various electroscopes, and the treatment is both detailed and lucid. Much useful advice in the construction of home-made instruments is given, and the student is also told how to surmount the various difficulties which arise. Chapters iii. to vi. are devoted to the practical exercises previously referred to, the number which can be performed by means of simple apparatus being surprisingly large.

The remainder of the book is intended for original investigators rather than ordinary students. Here the methods of making accurately standard radio-active measurements and the separation of radio-active substances are treated in considerable detail. These, together with the appendices concerning radio-active constants, ranges of particles, rates of decay, &c., cannot fail to be of the utmost use to those interested in the extension of knowledge in this sphere. Lack of space forbids as detailed a description as the work deserves, but it can be confidently stated that it will prove its own recommendation.

(3) This is the first of a series of four little books on practical physics which the author proposes to publish. It is intended to form in schools a first year's course, and deals with measurements in mechanics of solids and fluids. The instructions are given in a very clear manner, and the student is told in every case exactly how to record the results. The arrangement of the book and the diagrams are excellent, rendering it quite one of the best of its kind.

(4) This is another book on practical physics, but one of a much more extensive and advanced character. The experiments described are those on general physics and properties of matter which are suitable for the advanced classes in colleges and technical schools. A knowledge of the calculus is assumed, being used for the theoretical treatment of many of the exercises. Students are instructed in the methods of eliminating errors, and advised as to the precautions necessary to secure accurate results. The author has been very thorough in this respect, and his work compares favourably with the various standard text-books of practical physics.

(5) Here is yet another book on elementary practical physics for use in schools. The two volumes deal respectively with mechanics, and heat and light. The method adopted is to ask a series of questions, the answers to some of them depending merely on theoretical knowledge and the others involving practical observations. In all cases space is provided in the book itself for the student to record the answers and results beneath the exercise itself. This certainly seems to be carrying this method of teaching a little too far, for in the case of the slovenly student the result will be that the book will be spoilt, while to the tidy student such spoon-feeding is quite unnecessary. The instructions given are rather meagre, and no diagrams are used for purposes of illustration.

(6) Dr. Lecher's book is a simple treatise on physics specially intended for students of medicine and biology. The author has endeavoured to make the subject appeal to them by the frequent introduction of illustrations drawn from their own subjects. Naturally the book is quite elementary in character, but the scope is fairly comprehensive from a descriptive point of view. Some of the diagrams are rather old-fashioned, depicting, as they do, persons performing experiments, but they are well and clearly printed, as is also the text.

(7) A book such as this of Dr. Houstoun's has long been needed. Many students of physics have experienced considerable difficulty both in selecting and in understanding the various treatises on mathematical physics which they ought to read. The present work will serve as an introduction to a variety of subjects, and the treatment is such that a student with a fair knowledge of the calculus and physics should be able to read it with comparative ease. The six chapters of the book deal respectively with attraction, hydrodynamics, Fourier series and the conduction of heat, wave motion, electromagnetic theory, and thermodynamics. There is also a series of examples at the end of each chapter. One is inclined to think that the section on thermodynamics is scarcely so extensive as the subject deserves, at any rate in comparison with the space devoted to the other sections. Standard works on thermodynamics are, however, more readily available to the average student; consequently this defect is less serious than it might otherwise have been.

(8) In this little popular treatise on electricity Prof. Adami manages to describe in non-mathematical language various principles in electricity and their applications to important practical developments. The book is nicely got up, and the diagrams are exceedingly well produced.

OUR BOOKSHELF.

The Electron Theory. By Prof. Toshinojo Mizuno. Pp. 336. (Tokyo: Z. P. Maruya and Co., Ltd., 1912.)

IN this book, which is intended for Japanese readers, Prof. Mizuno, of Kyoto Imperial University, gives the substance of a course of lectures which he delivered in 1911 at the Kyoto summer school. Beginning with the vacuum tube discharge, the author leads his readers through the various phenomena associated with the Zeeman effect, Brownian movements, Lenard and Röntgen rays, up to the modern conceptions of the structure of the atom. In this connection the hypothetical forms of stable configurations are discussed at considerable length. There then follow fairly detailed sections on the constitution of the spectrum lines, on radio-activity, on the energy quantum theory, on the longitudinal and transverse mass of electrons, and the like. Towards the end the principle of relativity is introduced in connection with Michelson and Morley's classical experiments.

The author makes no claim to any originality of treatment; but he has made himself master of the growing literature of the subject and has endeavoured to give a connected view of the many phenomena described. He is not satisfied with the present state of speculation and hypothesis, and hopes for the coming of a great mind which will unify the whole.

Luftelektrizität. By Dr. Karl Kähler. Pp. 151. (Berlin and Leipzig: G. J. Göschen'sche Verlagshandlung G.m.b.H., 1913.) Price 90 pfennigs.

THIS is one of a long series of cheap, instructive books published by the firm of G. J. Göschen. The principal contents are the earth's potential gradient, forty-four pages; the electric conductivity of the atmosphere, thirty-five pages; electric currents in the air (including the ordinary fair-weather vertical current, electricity brought down by rain and snow, and lightning), twenty-nine pages; and the radio-active phenomena of the atmosphere, twenty-eight pages. Two other shorter sections deal respectively with the electric effects of sunshine and theories as to the source of atmospheric electricity. There are eighteen figures in the text, including some interesting Potsdam records of potential gradient during calm and disturbed weather. The author is a member of the staff of the Royal Meteorological-Magnetic Observatory at Potsdam, and is a recognised expert on the subject of which he treats. Considering its size, the book gives an excellent account, clear as well as concise, of the whole subject. German results loom somewhat more largely than they probably would in a text-book written in France or England, but there are a good many references to non-German writers, including Chauveau, Simpson, and C. T. R. Wilson.

Leçons sur les Hypothèses Cosmogoniques professées à la Sorbonne. By H. Poincaré. Edited by H. Vergne. Pp. lxx+294. Second edition, with a Portrait and a Memoir on H. Poincaré by E. Lebon. (Paris: A. Hermann et Fils, 1913.) Price 12 francs.

THE first edition of this work was given an extended notice in the issue of NATURE for May 2, 1912 (vol. lxxxix., p. vi). The present issue has been enriched by a portrait of Prof. Poincaré, and by the inclusion of a biographical notice and critical estimate of the eminent savant's work by M. E. Lebon, who has in addition made a few necessary corrections in the text.

A Manual of Agricultural Chemistry. By H. Ingle. Third edition. Pp. vii+397. (London: Scott, Greenwood and Son, 1913.) Price 7s. 6d. net.

THE first edition of Mr. Ingle's book—reviewed in the issue of NATURE for July 10, 1902 (vol. lxvi., p. 245)—dealt with the chemistry and physics of subjects relating exclusively to English agriculture. In the present edition, however, reference has been made to the chemistry of crops of tropical and sub-tropical countries, as well as to questions of stock-feeding in other lands. In addition, the book has been revised, and to bring it up to date some portions have been re-written.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Some Phenomena Connected with Reflected X-Rays.

THE diagrams shown in Figs. 1 and 2 represent photographs obtained when X-rays were reflected on rock-salt and quartz. The spots lying on the left of the vertical line are due to the rays which have passed directly through the crystal, while those on the right are produced by reflected rays. It is easy to see from Fig. 2 that there are five spots due to the impact of the reflected rays. The middle spot and the two on the outside are more intense than the two others. The optical axis of the quartz specimen lies in this case in the plane of incidence forming an angle of 1′ with the surface of the crystal.

An explanation of the different spots of reflection shown in Fig. 2 can be given with the help of Fig. 3,

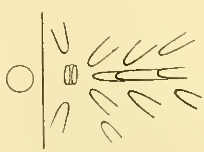


FIG. 1

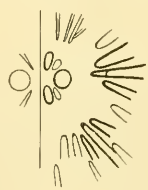


FIG. 2.

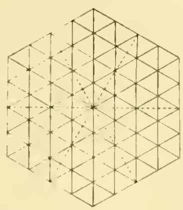


FIG 3.

which is meant to show a cross-section of a hexagonal crystal cut at right angle to the optical axis. The points of intersection of the lines drawn in full may represent the positions of the molecules in the crystal. Considering this figure we can assume that the more intense rays are reflected by the layers which are parallel to the lines drawn in full, and the weaker ones by layers which are parallel to the dotted lines. It is obvious that in the first case the molecules lie closer together than in the second.

In addition, in Figs. 1 and 2 there are seen a series of lines which seem to converge towards the points of impact of the reflected rays, and are distributed in a way which is very similar to a spectrum obtained with visible light by means of two crossed gratings. Provided that in our case the phenomenon is due to an effect similar to that of crossed gratings, the directly reflected rays must be regarded as spectra of the order zero. On account of the diffusion of the lines, however, it is not possible at present to deduce from this the wave-length of the X-rays.

E. HUPKA.

Physikalisch-technische Reichsanstalt,
Charlottenburg, April 12.

Diffraction Patterns from Crystals.

THE attention given, in this laboratory and elsewhere, to the effects produced by passing a beam of Röntgen radiation through crystals suggested to me that it might be of interest to examine the image produced when a narrow pencil of ordinary light falls on a photographic plate after passing through a crystal. The lens was removed from a camera, and in place of it there was attached a tube about 30 cm. in length and 3 cm. in diameter. The tube was lined with black velvet, and provided with three diaphragms pierced with pinholes from one-half to three-quarters of a millimetre in diameter. In this way I endeavoured to secure that a cylindrical pencil of light of small cross-section should enter the camera. In consequence of diffraction at the last aperture the impression on the photographic plate, when no crystal was interposed, sometimes extended over a considerable area, resembling the diffraction images recently discussed by Mr. J. W. Gordon (Proc. Phys. Soc., vol. xxiv., p. 428, 1912).

The crystal to be investigated was placed at a distance of about 5 cm. from the last aperture, and about 20 cm. from the photographic plate. The resulting image often showed lines or streaks radiating from the centre at angles depending on the crystal and its orientation. These effects are obtained only


Selenite.


Phlogopite.

by giving a prolonged exposure or using an intense source of light. With a mercury-vapour lamp, five or six hours' exposure was given; with diffused daylight, several days' exposure was required; but by employing the direct light of an arc lamp an exposure of five or ten minutes was found sufficient.

I have only found such radial streaks in cases where the crystal showed a more or less streaky appearance when examined by the naked eye. It seems clear that the striations in the crystal act just like a diffraction grating. In the case of selenite the *complete* pattern resembles an eight-rayed star; the angles between the radial streaks seem to agree with the angles between the axes *a* and *c* and (possibly) the first and second median lines.

I desire to thank Dr. Sibly and Dr. Tutton, to whom some of the photographs were submitted, for crystallographic information. Dr. Tutton writes:—

"I should think the phenomenon of the streaks in the photograph is due to the well-known 'asterism.' Asterism is particularly well shown by mica, especially the variety known as phlogopite. It is due to fine enclosures arranged along the glide-planes, and parallel to the cleavage plane. It shows itself as a six-rayed star (or occasionally twelve-rayed) when the mica is held between the eye and a bright source of light. Calcite also shows asterism, certain crystals held in front of a candle flame showing a radiating star of light. In this case, however, it is due to tubular cavities parallel to the glide-planes (the rhombohedron known as $e\{110\}$). Some sapphires also show asterism, and here again it is due to tubular cavities in planes parallel to the prism $\{10\bar{1}\}$. I am not aware that selenite has been studied for asterism. I should think it is very likely that certain specimens will show it, those rich in cavities or enclosures. The cavities would probably be parallel to the perfect cleavage plane (the symmetry plane $b\{010\}$ along which selenite crystals are tabular), and possibly along the two minor cleavage directions $a\{100\}$ and $n\{\bar{1}11\}$, the former of which would be parallel to the vertical axis *c*. They might also lie parallel to the inclined axis *a*. In this case your phenomenon would be at once explained."

Although the results obtained do not reveal any new physical phenomenon, I shall be glad if the experiments prove of interest to the crystallographer as affording him a convenient method of studying certain features of crystal structure. H. S. ALLEN.

Wheatstone Laboratory, King's College, London.

Bird Protection and the Collector.

THE protection and preservation of wild birds in Great Britain is in these days beset with difficulties of many kinds; but as regards especially the preservation of the rarer birds of our country, the one great and ominous danger is the individual whom Sir Herbert Maxwell has described as "the cursed collector." At this time of the year the professional collector of eggs infests the country wherever rare species are known or discovered to breed, and wherever clutches are to be had which have their value in the market. At all seasons of the year the professional collector of birds is despoiling the land of the noble, the beautiful, the unfamiliar forms of bird-life that hide in diminished numbers among little-frequented commons and heaths, mountains and lakes, woodlands and forests, or visit the country in small numbers and nest at their peril, with a price upon their heads and upon every egg they lay.

It may indeed be said that while a percentage of naturalists are working to protect birds, to keep up the number of our native species, and to bring about some comprehension of the living creature, others are eager only to secure for themselves, by hook or by crook, the skins and feathers, and the empty shells, to fill their cabinets or to sell or barter. As one of their number has written, with unconscious irony, the preservation of a bird should begin as soon as it is killed.

A correspondent of *The Times* wrote the other day of the egg-collector:—"These pests know no boundaries and observe no laws which stand between them and the objects of their rapacity." Could the experiences of some of the workers in this society be divulged the truth of that statement might be thoroughly demonstrated. Neither the "rarity" collector who values the "British-taken" bird or egg solely because it seldom occurs or is on the verge of extinction in Britain, nor the "rarity" collector to whom the speckles on an eggshell are things of absorbing interest, will stop at any artifice or any dodge in pursuit of his quest.

The problem lies in this, that the offenders are largely men of wealth and position, officers in the Army, clergymen, "ornithologists," popularly known for their interest in bird-life, and even for their pronouncements in print on bird protection; and that these collectors not only snap their fingers at the law and take pride in evading and transgressing its provisions, but employ trade agents and dealers to work for them, and give heavy bribes to poorer men—men in the responsible position of keepers and coastguards, and also fishermen, shepherds, and others whose ignorance and poverty render them ready cat's-paws. The gamekeeper receives an intimation that a certain firm of "naturalists" will be happy to hear from him with regard to certain birds or eggs which may come to his notice, and will give him handsome terms; possibly the owner of the estate inquires later on whether a notable species which he was a little proud to have on his land is still there, and is told that it unfortunately attacked the chicks and had to be shot, or, more simply, that it has "disappeared." The crofter or the fisherman is told that the rich visitor at the hotel gives a wonderful sum for such-and-such eggs, which he hears are found on a neighbouring islet or moor, or that he wishes to be taken to see a nest, and will pay his guide well; and in a few years the bird has ceased to breed in that neighbourhood.

The creation of reserves has been advocated; various areas have been described in county council orders as "protected," in which birds or eggs may not be taken. But the creation of reserves or the definition of areas will not in themselves check unscrupulous collecting. For some years this society has, with the best results, employed watchers to guard certain breeding-places of rare birds. Some score of these are scattered over Great Britain, from the Shetlands and Orkneys to Sussex and Cornwall, and more will be employed as the much-needed funds permit; but the utmost care has to be exercised in their appointment; they must have fair pay to protect them to some extent from the temptation of bribes; and members of our watchers' committee visit their stations from time to time to inspect and judge actual results. Brean Down, of which the society rents the shooting rights, we hope to make a complete reserve for birds. It is exceptionally well suited for the purpose, and cannot well be visited without the knowledge of the watcher. Dungeness is a "protected area" guarded by the society's watchers during the breeding season. Yet at Dungeness a collector took advantage of a permit obtained by an unsuspicious friend to pocket all the eggs he could seize upon; followed by a watcher he was compelled to disgorge and restore every one. At Brean Down last spring the solitary young bird was taken from the peregrine's eyrie; an honorary watcher, discovering what had happened, pursued the culprit by motor-car, obtained the bird, brought it back to the down, and with considerable difficulty restored it to the nest.

On a protected island, a few seasons ago, permission to view was again gained by stratagem, and the visitor, closely followed, was at last impelled to say that "it was a pity to leave such nice eggs," and he would stand the consequences of taking them; the consequences happily worked out at 1*l.* per egg, and the eggs were forfeited. In Scotland the society has had to employ detective-inspectors, whose work called for vigilant circumspection. In Wales the kites' nests have to be guarded day and night. In many cases the eggs of harriers, ravens, peregrines, and other species are taken year after year, so that no young bird is ever reared, and only the presence of keen and determined watchers can stop this, or prevent the destruction finally of the parent birds. To the collector the idea of extermination of a species can suggest no regret; it would but add to the value and interest of his specimen.

Reserves and county council orders are admirable in intention; the latter are useful as affording possibility of conviction and fine where offenders are caught in the act. But as deterrents they avail nothing for persons of this class, and unless carefully worded may indeed serve to advertise the presence of a rare species. A law to deal with possession and the possessor is now absolutely necessary, as well as a strong public opinion which shall cause these collectors to be held in the contempt they deserve and shut them out from the society of decent naturalists. One proposal as to the kind of law needed has been made by Mr. W. H. Hudson ("Birds and Man," chap. xii.):—

"There is really only one way out of the difficulty—one remedy for an evil which grows in spite of penalties and public opinion—namely, a law to forbid the making of collections of British birds by private persons. . . . Without such a law it has now become impossible to save the best of our wild bird-life."

The words are even more true now than when they were written, and the time is more ripe for translating them into action. The old idea that not only must the ornithologist make collections, but that collections make the ornithologist, is giving way before the nature-reserve and the nature-student. But if the nature-reserve and the prohibition to take rare birds and rare eggs are to be more than a comfortable delusion, the open advertisement and the secret circular, the open incentive and the secret bribe for "procuring" specimens and for harrying nests, must be put a stop to. The source and motive, the *fons et origo*, of all these things is the private collection.

L. GARDINER,

Secretary, Royal Society for the Protection of Birds.

23 Queen Anne's Gate, London, S.W.

Mechanically-formed Grikes in Sandstone.

IN the Lower Old Red Sandstone of the west of Caithness I have noticed an appearance which recalls the grikes due to erosion of which Mr. Carus-Wilson writes in NATURE of May 1. It is seen in the platform of marine denudation in a minor inlet on the north coast at the village of Reay, eleven miles west of Thurso. The dip of the rocks varies from 10° to 30°, averaging 17°, 10° west of north, and the low scarps, lying transverse to the axis of the bay, run down to the sea, giving rise to the tiny inlets locally known as "ports," or "porties."

At the harbour begins a thick sandstone, stretching in a southerly direction to a thickness of about 120 ft., which appears to pass laterally into the grey and blue flags so prevalent in the area. Separated from the main body of the sandstone by a flaggy sandstone and blue flag is the thin sandstone in which the "grikes" are seen.

There does not seem to be any lithological difference between the rock of the main body and that of the layer with the "grikes." Both are grey sandstone, which weathers to a light reddish-brown colour, and there is an appreciable amount of hæmatite present surrounding the quartz grains which make up the bulk of the rock. Felspars are fairly numerous and fresh, and there are wisps both of muscovite and biotite. The cement is largely micaceous, but calcite is present, and there has been some deposition of quartz from solution. The quartz grains are not well rounded.

The grooves are smaller than those Mr. Carus-Wilson mentions; the largest are about a foot deep and four inches wide, but the length of the longest is well over 16 ft. They run in two directions at right angles, parallel to the dip and strike, and the network is at places so fine that miniature stacks stand out, about 4 in. square in section.

As the place is about 40 yards below the beach of very coarse shingle one turns from the erosion hypothesis, and the slightly pitted nature of the rock surface suggests solution. Alex. Stevens.

Geological Department, University of Glasgow, May 6.

The Mountains and their Roots.

Major Cowie's letter in Nature of May 8 gives the impression that I had the facts of the observations on the deflection of the plumb-line in India before me, and that I made my assumptions as to relative densities, and the mode of compensation by extension of depressed crust beneath the plains, "suitably adjusted," so as if possible to bring out the desired results. This was not the case. I made the assumptions about relative densities which seemed to be *a priori* probable; and it will be seen from the diagram at p. 184 of my "Physics of the Earth's Crust" that fifteen years before I wrote the paper in the *Phil Mag.* I had suggested that compressed mountains would be partly supported by an extension of the depressed crust beyond them.

Should anyone be inclined to undertake the labour of calculating from my formulæ, introducing fresh constants, or other distances, I would warn him that in the *Phil. Mag.* there is a misprint. In the formula for the plateau, after the first bracket, insert x.

I am much pleased that after so long a time my theories are under discussion, and I hope to come well out of it. I am sending to the *Geological Magazine* a reply to some remarks by Sir T. H. Holland in that journal, and to this I would refer your readers as more fully giving my views on some of the points under discussion. O. Fisher.

Graveley, Huntingdon, May 9.

An Application of Mathematics to Law.

I have read Mr. Potts's letter in Nature of April 24, but am at a loss to understand the use to which he would put his equations.

If it be his object to find some equation giving the validity of a patent or foretelling in any way the probability of its being upheld in a court of law, he has clearly failed to do anything of the sort.

If his equation $I = M + i$ is to be of any value, the quantity i must have a fixed value greater than zero. In fact, however, for any given patent, i may have an infinite number of values, including zero, since each person will have his own idea of the amount of ingenuity that must be shown in the particular case by the inventor. Thus the inventor will certainly put a high positive value upon i, while his opponent will as certainly say that the value of i is zero. It is clear that the value of i can only be finally settled when the validity of the patent has been settled by the House of Lords, and at this stage of a patent's career it is scarcely necessary to have an equation to test its validity. So far as the rest of his letter goes, he seems to have chosen a rather complex method of setting out a few of the chief principles of patent law. R. Stafford Cripps.

Fulmer, Slough.

I did not imagine that my letter would be taken as an attempt to supersede the present methods of determining validity. I intended it as a contribution to the theory which underlies the enormous volume of our case-law on the subject. Surely, as in other cases of the progress from empiricism to science, the first step must be in the direction of mathematical or symbolic expression of the facts. The value of such a symbolism is twofold: first, as an aid to precision of thought; and second, as a preliminary to generalisation. It is a vital principle of English law that all decisions shall harmonise with precedents as much as possible, and on this account alone anything should be of value which assists in formulating generalisations. We admit the value of theory in the physical sciences, apart from immediate practical results: why should an attempt to develop a theory of law be condemned because it does not at once do away with the functions of the judge?

Mr. Cripps's difficulty as to the value of i will not be so great if the actual cases given in my letter are studied. I may add here, however, that it is immaterial what this value is, provided that it is measurably greater than zero. It is settled law that a scintilla of ingenuity is sufficient to support a patent for something new and useful (*cf.* Thompson *v.* Amer. Braided Wire Co., in the House of Lords, and other cases). I therefore employed this symbol merely to indicate that there had to be some positive difference. Harold E. Potts.

University Club, Liverpool.

SYNTHETIC BIOLOGY AND THE MECHANISM OF LIFE.

The presidential address delivered by Prof. Schäfer to the British Association in 1912, and the subsequent independent discussion at a joint sitting of two of the sections, served, as was pointed out by Prof. Armstrong in a paper in *Science Progress* in October last, "as a useful corrective to the wave of vitalism that has passed over society of late years owing to the pervasive eloquence of Bergson and other writers." Probably the majority of those who have studied the phenomena of life from the chemical side will agree with Prof. Schäfer in his dictum that "at the best vitalism explains nothing," and accept his opinion "that we may fairly conclude that all changes in living substance are brought about by ordinary chemical and physical forces." The difficulty, however, lies in obtaining any satisfactory information as to what are the actual chemical or physical changes which occur in the real living cells or tissues. Since this discussion was held Prof. S. Leduc, of the School of Medicine at Nantes, has published a monograph[1] in which he approaches the problem from the novel point of view which now for several years past has guided his experiments and with which readers of his "Mechanism of Life" will be familiar.

It is impossible to do justice to the author's arguments or make clear the proper value of his demonstrations in a short article such as the present, but this will at least serve to direct attention to a few of the very remarkable results that he claims to have achieved, which, if verified, are certainly of the highest significance to the student of the phenomena of life.

The basis of Prof. Leduc's work may be summarised in his own words as follows: "It is in the physico-chemistry of liquids that an explanation of the phenomena of life is to be sought"; and he develops his views largely by studying the nature of diffusion in liquids and the phenomena

1 "La Biologie Synthétique." By Prof. Stéphane Leduc. Pp. ii + 217 (Paris: A. Poinat, 1912.)

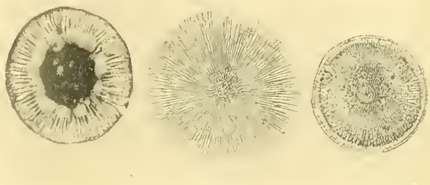
that are thereby produced. He regards diffusion as brought about by currents which radiate to and from the centres of greatest concentration; when a drop of solution of higher concentration is placed in a solution of lower concentration, the drop becomes the centre of symmetrically radiating currents, the one set, consisting of the solution of higher concentration, radiating outwards (centrifugal), the other set (centripetal) radiating inwards and consisting of the solution of lower concentration. "The force producing the currents is the osmotic pressure. Their centres of emission, true dynamic centres or poles, are of two kinds: centres of osmotic pressure greater than that of the medium or positive poles of diffusion, and centres of lower osmotic pressure or negative poles of diffusion. Around these poles of diffusion the dynamic and kinetic phenomena are the same as those which exist in the æther around electric or magnetic poles; the same mechanical laws control them, and a molecule is displaced in the liquid exactly like an ion in an electric field." Photographs are given by Prof. Leduc which show that, for example, a drop of tinted water diffuses into a saline solution along lines which exactly correspond with the discharge from an electric point or with the lines of force from the pole of a magnet. "It is the graphical representation of a centre of force such as was demonstrated by Faraday." Concentric circles of concentration are produced by diffusion which correspond with Faraday's equipotential surfaces.[2]

By utilising differences of concentration and the accompanying osmotic and chemical phenomena under different conditions and with different substances and media, Prof. Leduc states that he has been able to reproduce many phenomena which have hitherto been regarded as characteristic exclusively of living matter. Of a few of these a brief description is appended.

Cell Synthesis.—Of the many different types of cell which Prof. Leduc states that he has "synthesised," the photograph, Fig. 1, shows three varieties: A is an artificial cell produced by a drop of solution of triammonium phosphate in a solution of sodium carbonate and trisodium phosphate; the "nucleus" is large and the analogues of the protoplasmic processes and the enveloping membrane thick. The middle figure B is an artificial aster produced by a drop of water tinged with Indian ink in a solution of potassium nitrate. C shows an artificial cell with interior granulations. When such cells are prepared with a precipitated membrane composed, for example, of calcium carbonate or phosphate, they grow in size owing to the fact that the centripetal diffusion (of water) is greater than the centrifugal, the surrounding membrane becoming correspondingly extended.

[2] Reference may here be made to a paper by Dr. Horace T. Brown and F. Escombe on static diffusion of gases and liquids, &c. (Phil. Trans., 1900, 193 B, 223), which is not referred to by Prof. Leduc, but substantially corroborates his views on these points. In this paper it is shown that the lines of flow of gas or solute diffusing through a perforated diaphragm are the analogues of the lines or tubes of force, and the shells of equal density or concentration obtained the analogues of electrical surfaces of equipotential.

Karyokinesis.—The reproduction artificially, by very simple means, of all the phenomena characteristic of karyokinesis is one of the most striking achievements to which Prof. Leduc lays claim. The photograph (Fig. 2) shows four successive periods of cell-division reproduced by diffusion. "If in a saline solution there is introduced between two tinted drops, of less or greater concentration than the solution and representing the centrosomes, a drop of solution very slightly more or less concentrated than the solution and representing a nucleus, all the transformations, all the movements,

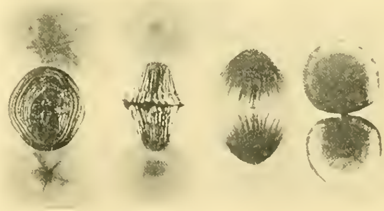


A B C

FIG. 1.

and all the figures characteristic of nuclear division are seen to unfold themselves in their proper sequence and regular order." In the figure A shows the spirem stage, B the orientation of the chromatic substance in the equatorial plane, C the chromosomes on their way to the centrosomes, and D the two final cells produced as a result of the action.

Multiplication.—If an artificial cell is kept for a sufficient time in the liquid from which it has been formed, after a time a furrow appears in the interior of the cell and later other furrows



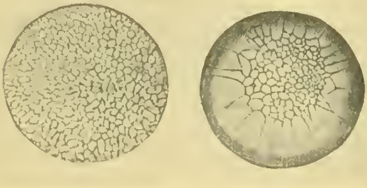
A B C D

FIG. 2.

appear which split up the cell into secondary cells, the number of which rapidly increases until the artificial cell becomes nothing but a group of secondary cells—that is, an "artificial morula." Fig. 3 shows a comparison of the germinative disc of a hen's egg (A) with the segmentation of an osmotic cell produced artificially.

Nutrition and Development.—In a chapter on the physiology of nutrition, illustrated by a number of striking photographs which we cannot reproduce here, Prof. Leduc contends that the "faculties of nutrition, absorption, elaboration or chemical metamorphosis, assimilation, elimination, growth, development, functional differentiation, organisation, inanition and disease are shown by osmotic growths exactly as by living organisms." Striking examples of a comparatively high degree of organisation are given in the chapter on "morphogeny," such, for instance, as the capsular terminations of the filament-like growths obtained with manganese salts, or the "osmotic fungi" which very closely resemble natural fungi in their appearance and structure. One of the most interesting features of these growths is the selective distribution of colour in the different parts, one portion of which may be, for instance, greenish-white, another light green, another part dark green and other parts golden yellow.

Phototropism, galvanotropism, &c.—Prof. Leduc contends that the majority of such phenomena as phototropism, chemotropism and galvanotropism, which have been regarded as essentially vital phenomena, can be artificially reproduced with purely mineral or unorganised material. If, for example, a bath of a salt solution is placed so that one half is illuminated and the other half



A B

FIG. 3.

is in darkness, and a drop of water tinted with Indian ink is added, "the particles of carbon abandon the illuminated portion and take refuge in the dark part." These and similar results are utilised by Prof. Leduc in a discussion of the nature of the changes occurring in the production of sense impressions. One of the most striking phenomena in this domain, the deformation of the ovule, with the production of a protuberance on the side of the spermatozoid, which Sachs called "the most surprising phenomenon in fecundation," Prof. Leduc claims to have reproduced artificially in a very simple way: If near an artificial cell (hypotonic), produced in a non-saturated solution of potassium nitrate, a small crystal of potassium nitrate be placed, not only is the artificial cell deformed with a protuberance on the side of the crystal, but the lines of circulation within the cell are evidently also influenced.

In this small treatise 118 photographs are reproduced, each of which is said "to be expressive of a fact and to represent the result of a series of experiments." It has here been possible only to outline in the most general manner the character and scope of the work. W. A. D.

SEMI-CENTENNIAL CELEBRATION OF THE NATIONAL ACADEMY OF SCIENCES IN WASHINGTON.

THE National Academy of Sciences of the United States celebrated the fiftieth anniversary of its foundation on April 22–24 at Washington. A special programme was arranged, and many distinguished guests were invited to participate in the celebration. In recognition of the function of the academy as the scientific adviser of the Government, President Wilson, Vice-President Marshall, and Chief Justice White took part in the exercises.

The celebration was held at the Smithsonian Institution, and began on the morning of April 22 with an address by the retiring president of the Academy, Dr. Ira Remsen, who reviewed the history of the organisation and gave an account of the scientific labours of the incorporators, and of the various trust funds of the academy.

Dr. Remsen was followed by President Hadley, of Yale University, whose theme was the relation of science to higher education in America. An address was then delivered by Dr. Arthur Schuster, F.R.S., on international cooperation in research. After a luncheon the academy and guests listened to a brilliant lecture by Dr. G. E. Hale, director of the Mount Wilson Solar Observatory, on the earth and sun as magnets. The lecture was illustrated by lantern-slides and experiments. In the evening a reception was given by the regents and secretary of the Smithsonian Institution, the hosts being Vice-President Marshall and Chief Justice White, Chancellor of the institution.

On the morning of April 23 an address was delivered by Dr. J. C. Kapteyn, director of the astronomical laboratory of the University of Groningen, on the structure of the universe. In the afternoon the academy and guests assembled at the White House, where certain medals and prizes of the academy were presented by President Wilson. Dr. R. S. Woodward, director of the Carnegie Institution of Washington, read the reports of the committee on the awards, after which the President handed the medals and prizes to those who were to receive them, or to their representatives, prefacing his action by brief remarks in which he gracefully referred to the academy as a great society, and as one long associated in an advisory capacity with the Government of the United States. The awards were as follows:—

The Watson medal to Dr. J. C. Kapteyn in recognition of his bold, penetrating researches on the problem of the structure of the stellar universe. Dr. Kapteyn received the medal in person.

The Henry Draper medal to M. Henri Deslandres, of Meudon, France, for his noteworthy researches in astrophysics. M. Deslandres not being present, the medal was delivered to the French Ambassador, M. Jusserand.

The Agassiz medal to Dr. Johan Hjort, of Bergen, Norway, for his meritorious contributions to the science of oceanography. In the absence of Dr. Hjort, the medal was received by the Norwegian Minister, Mr. Bryn.

The Comstock prize of 1500 dollars to Prof. Robert A. Millikan, of Chicago, for his demonstrations of the existence of electric atoms in elements and of the equality of the electrical charge of positive and negative ions in ionised gases, and his additions to the knowledge of the molecular constitution and kinetic phenomena of gases.

A business meeting was held on the morning of April 24, when the following officers and new members and foreign associates were elected: *President*, William H. Welch; *Vice-President*, Charles D. Walcott; *Foreign Secretary*, George E. Hale; *Home Secretary*, Arthur L. Day; *Treasurer*, Whitman Cross. *New Members:* Henry A. Bumstead, Gilbert N. Lewis, Louis V. Pirsson, Erwin F. Smith, Leonard E. Dickson, Lafayette B. Mendel, Edward B. Rosa, Ross G. Harrison, George H. Parker, Armin O. Leuschner. *New Foreign Associates:* Arthur Schuster, Theodor Boveri, William Crookes, Gaston Darboux, Henri Deslandres, Albert Heim, Albrecht Kossel, Karl Friedrich Küstner, Johannes D. van der Waals, August Weismann, Max F. J. C. Wolf.

On the afternoon of April 24 an excursion was made to Mount Vernon on the U.S.S. *Mayflower*, which had been placed at the disposal of the academy and its guests by the Secretary of the Navy. In the evening a banquet was held in the New Willard Hotel, at which speeches were made by Vice-President Marshall, the Right Hon. James Bryce, President Remsen, Dr. S. Weir Mitchell, Senator T. E. Burton, of Ohio, and Dr. W. W. Keen, President of the American Philosophical Society.

To mark the anniversary, the academy published a history of its first half-century in a handsome volume of some 400 pages. It includes an account of the founding of the academy, its annals, biographical sketches of the incorporators, and a chapter on the work of the academy as the scientific adviser of the Government, together with appendices, among which is a list of publications.

SCALES OF FISH AS TESTS OF AGE.

THE general principle that the age of a fish may be determined by a study of the markings on the scale has now been generally accepted for many fishes, especially for the Gadoids, Clupeoids, and Salmonidæ. It has been maintained, especially by Norwegian naturalists, that the principle may be carried still further, and that from a measurement of the portions of the scale representing the growth of successive years the length of the fish at the end of each year of its life may be calculated. If this proved to be true, the average annual growth rate of fishes could be determined by the examination of comparatively small samples of fish, since each of the older fishes would give values for a number of years.

That the use of the method in this way must be undertaken only with great caution is clearly shown in a paper by Miss Rosa M. Lee, published by the International Council for the Study of the Sea (*Publications de Circonstance*, No. 63), entitled "An Investigation into the Methods of Growth Determination in Fishes." By an acute and penetrating analysis of the measurements of scales from herring, haddock, and trout, Miss Lee shows that if the lengths of the fish at the end of each year are calculated from the lengths of the annual rings on the scale, measured from the centre of the scale along its major axis, the figures obtained appear to indicate a change in the growth rate of such a nature that the younger fishes attained a greater size at any given age than was attained by older fishes at the same given age. Thus whereas in a sample of herrings the four-year-old class gave an average calculated length of 25·8 cm. at the end of the third year, the ten-year-old class gave an average calculated length of only 21·3 cm. at the end of their third year.

Various hypotheses are put forward to account for this phenomenon, of which the most probable seems to be either that it is due to an actual shrinkage during the later life of the fish of the portion of the scale already laid down, or that in the samples of fish examined there has been a segregation according to size of such a character that only the larger sizes of the earlier age groups are present. The subject is clearly one which must be further investigated before certain conclusions as to age can be arrived at from the study of fish scales.

THE ROYAL SOCIETY CONVERSAZIONE.

THE annual May conversazione of the Royal Society was held in the rooms of the society at Burlington House on Wednesday, May 7. During the evening lantern demonstrations were given by Mr. Leonard Bairstow illustrating cases of eddying fluid motion of interest in aëronautical research, and by Dr. A. Smith Woodward on the discovery of a palæolithic human skull and mandible at Piltdown, Fletching, Sussex. Many objects and instruments illustrating recent scientific methods and results were exhibited, and most of them are described in the subjoined summaries from the official catalogue. Exhibits referring to related branches of science have, so far as possible, been grouped together.

Prof. J. T. Morris: The electrical measurement of wind velocity, as applied to the distribution round a circular rod in an air current. In the air current is fixed a Wheatstone bridge made with alternate arms of platinum and manganin. At normal temperature this bridge is out of balance. It is supplied with either (*a*) a constant voltage, when a millivoltmeter in place of the usual galvanometer gives indications depending on the wind velocity; or (*b*) a current which can be varied so as to bring the bridge into balance for any velocity; the square of the watts used in the bridge wires is then proportional to the wind velocity subject to a small correction. It is unnecessary to know the direction of the wind before a measurement can be made. *Mr. M.*

O'Gorman: Instruments for aëronautical work, and research on aëroplane stability. (1) Ripograph: to record velocity, roll, pitch, yaw, and the corresponding movements of the flyers controls on a continuous photo-strip. (2) Velometer: to indicate speed through the air of aëroplanes and airships. (3) Trajectograph: to record the path through the air of aëroplanes. (4) Air distance recorder or log: to give miles passed through the air of aircraft. (5) Recording accelerometer. (6) An airship and aëroplane instrument board complete. (7) Tautness meter: to enable the pull on a wire to be measured without altering or cutting it, or putting fixtures on the wire. Suitable for using during flight. *Mr. J. D. Fry:* A micromanometer capable of detecting differences of pressure of the order of one-millionth of a millimetre of mercury. The difference of pressure to be measured is applied to the two sides of a stretched membrane; the centre of the membrane by its displacement twists a mirror which is suspended in a special manner, the pressure differences being indicated by the deflection of a spot of light. *National Physical Laboratory:* Apparatus for the rapid determination of the lifting power of samples of hydrogen. (*Mr. Guy Barr.*) The method employed depends on the principle of balancing columns commonly used for comparing the densities of liquids. From the reading of a gauge, when the pressure difference is balanced, the lifting power of the hydrogen is determined with an accuracy of about 0·02 per cent. From the lifting power the purity of the hydrogen may be deduced by making corrections to N.T.P. after observation of the volume of a known mass of air.

The Cambridge Scientific Instrument Company, Limited: (1) Apophorometer: an instrument designed by Prof. J. Joly, for easily obtaining sublimates from substances at high temperatures. (2) Rack barometer: a barometer of the marine type, in which a dial is substituted for the vernier in general use. The dial is divided to read directly in tenths of a millibar. (3) Stomatograph: an instrument which records the amount of opening of the stomata on a leaf. (4) Yaw indicator: this instrument is designed to indicate the direction of a current of gas in any plane. *M. C. V. Boys:* Rainbow cups—old and new patterns. The chief characteristic of the new pattern is the point support of the cup. The accurate work necessary with an axle is avoided and the friction is greatly reduced. The cup supported at a point is free to precess, and during this motion the coloured rings appear to expand and contract in time with the precession. The direction of precession is opposite to that of an ordinary top. *Sir John Thornycroft:* Model to illustrate the effect of a compound cross sea on vessels of various rolling periods. In the model a plane surface is supported on three points, two of which move vertically and the third is stationary. In the vertical motion of each of the two moving supports four simple harmonic motions are combined, and the phase of motion in the two differ by a quarter of their time period, and produce in the moving surface a symmetrical motion, resembling that of a small portion of a complicated sea in which similar waves are crossing at right angles. *Mr. R. E. Gillmor:* The Sperry gyro compass. To be efficient the gyro compass must be so suspended that there is almost an entire absence of friction about the vertical axis, while at the same time forces must be impressed upon the wheel itself about the horizontal and vertical axis to cause the wheel to rotate into the plane of the earth's rotation. In the Sperry compass both are accomplished by suspending the gyroscopic or sensitive element from a stranded wire, the top of which is held in a frame surrounding the sensitive element and made to follow it by a system of electrical contacts controlling a motor which drives the frame.

Underfeed Stoker Company, Ltd.: CO_2 thermoscope, a self-contained pocket instrument for the thermometric analysis of carbonic acid gas in furnace and other gases. The instrument operates by measuring the heat of reaction between CO_2 and dry pulverised caustic alkali. (See Nature, April 17, p. 171.) *Mr. F. W. Jordan:* Convection radiometer and thermo-galvanometer. This instrument is primarily intended for the measurement of feeble steady rates of evolution or absorption of heat. *Mr. Dugald Clerk:* Determination of the volumetric heat of air, carbon dioxide, nitrogen, and flame in the cylinder of the internal-combustion engine. The volumetric heats of various gases and flames have been determined by the method of alternate compressions and expansions described in a paper read before the society in 1906. The present investigation deals with gases at low and high temperatures, and gives values between 100° C. and 1000° C. Laws of cooling have also been investigated, and the remarkable effect of turbulence on the rate of flame propagation in engines has been demonstrated. *Prof. Leonard Hill:* Kata-thermometers or comfort-meters. Two large-bulbed spirit thermometers are used. The bulb of one is surrounded with muslin. The stem of each is marked with heavy black lines at 110° F., 100° F., and 90° F. Readings can be taken with the bulbs of the instruments (1) clothed; (2) exposed or shielded from radiant heat, *e.g.* a fire. By this means the heating and ventilation of rooms and the effect of clothes can be investigated and arranged so as to give (1) comfortable loss of body heat; (2) prevent depressing effect of uniformly heated air on cutaneous nerves. *Prof. L. R. Wilberforce:* Experiments with ripples. Ripples produced on a water surface by a vibrating dipper are projected by intermittent light so as to appear stroboscopically in slow motion. A phonic wheel drives the slotted disc which produces the intermittence, the motion being transmitted by fluid friction whereby a very uniform rotation is obtained.

Mr. E. Leitz: Ultra-condenser for the observation of ultra-microscopic particles. The ultra-condenser has been devised for ultra-microscopic observations, especially in the examination of fluids and gases. The condenser renders any ordinary microscope suitable for the purpose. It consists of two glass bodies, each having a reflecting spherical surface, cemented into a metal box fitted with a bayonet-jointed and rubber-faced cover. The cover is fitted with a disc of quartz which serves as a cover glass. Underneath, the cover glass has a cavity for receiving the liquids and gases for examination. The condenser is not intended for high-power observations, and therefore objectives of shorter focal length than 8 mm. may not be used. *Prof. J. Norman Collie and Mr. H. S. Patterson:* The presence of neon and helium in hydrogen after the passage of the electric discharge through the latter at low pressures. Whatever the explanation may be of the presence of neon and helium in hydrogen after the latter has sparked it seems to be certain that:—(1) Neon and helium cannot be obtained from either glass or from the electrodes by heating alone; (2) glass, when heated to near its softening point and subjected to the action of kathode rays, is not permeable to neon or helium, so neither neon nor helium diffuses into the apparatus from the atmosphere. *Mr. A. Fowler:* New lines in the spectrum of hydrogen. Certain lines which occur in the spectra of stars and nebulæ have been attributed to hydrogen by Pickering and Rydberg in consequence of numerical relationships with the well-known Balmer series. Some of these "cosmic hydrogen" lines have lately been produced by passing a strong condenser discharge through a mixture of hydrogen and helium. *Prof. H. H. Turner:* Diagram of sun-spot analysis. Wolf's sun-spot numbers 1750–1910 can be closely represented by the harmonics of a period of 156 years, the coefficients of which rise and fall in a regular manner. The familiar $11\frac{1}{7}$ year period is the fourteenth harmonic, and has the maximum amplitude; but periods near it, especially thirteen and fifteen, are also important. All the chief harmonics were determined approximately, and their sum is compared with the numbers showing that the residuals are small. *Capt. H. G. Lyons:* An ancient Egyptian astronomical instrument. The original of this instrument was found in Upper Egypt, and is now in the Royal Museum at Berlin. By means of the wooden "sight-vane," one observer aligned the plumb-line, which was held by a second observer, on the pole-star. The second observer then noted the passage of certain stars over the first observer's head, and thus determined the divisions of the night.

The National Physical Laboratory: Specimens illustrating the behaviour of metals at relatively high temperatures. (*Dr. Rosenhain and Mr. Ewen.*) In researches on the intercrystalline cohesion of metals their behaviour at temperatures near their respective melting points has been examined, both by heating *in vacuo* and by mechanical tests. The volatilisation which occurs in many metals at temperatures below their melting points results in the formation, on previously polished surfaces, of patterns corresponding to the structure of the metal. This constitutes a process of vacuum etching. *Prof. W. J. Pope:* A collection of artificial crystals. A number of large crystals of various salts prepared by slow crystallisation of aqueous solutions; most of the crystals are well-proportioned, and peculiarities of face development, &c., can be observed upon them.

Prof. E. B. Poulton: All-female families and mixed families of *Acraea encedon*, bred by Mr. W. A. Lamborn in the Lagos district. These researches indicate the existence of two castes of females, one of which produces mixed families and the other all-female families. Both require fertilisation. *Mr. L. Doncaster:* The moth *Abraxas grossulariata*: inheritance of tendency to produce unisexual broods. In six successive generations families consisting wholly of females have appeared. *Dr. S. F. Harmer:* Polyzoa of waterworks. (See NATURE, May 8, p. 260.) *Dr. W. S. Bruce, Scottish Oceanographical Laboratory:* Collection of deep-sea animals taken by the *Scotia*, Scottish National Antarctic Expedition, 1902, 1903, and 1904. While a few of the animals shown are representative of shallow-water antarctic fauna, the greater number are from depths down to 2645 fathoms, or about three miles. An important feature of the scientific results of the *Scotia* lies in the fact that the Scottish expedition was the only antarctic expedition which has been completely fitted for deep-sea research in high southern latitudes. *Marine Biological Association of the United Kingdom:* Living crabs and their allies arranged to show some of the various modifications of form and structure found in this group, and the relation between such modifications of structure and the mode of life of the animals. *Mr. Conrad Beck:* Marine Coscinodiscus showing filaments, shown under the microscope with high-power dark ground illuminator (mounted by H. J. Waddington). The filaments radiating from these diatoms were discovered by Mr. Siddall of Chester, and some controversy has arisen as to whether they are protoplasmic, pseudopodia, or silicious spines. They are readily seen with a low power, but require very oblique dark ground illumination, as used for high powers, to demonstrate them. *Mr. C. B. Williams:* British Protura. The Protura, first described by Silvester from Italy in 1907, and first recorded from England last year by Mr. Bagnall, are a group of primitive Arthropods the systematic position of which has been the subject of much discussion. Their chief affinities are with the Insecta or with the Myriapoda, and they have been considered by various authorities as members of these groups and as a separate class intermediate between the two. *Mr. H. G. Plimmer:* Blood parasites - new, or from new hosts.

Dr. S. Watson: Skull, mandible, shoulder girdle, and forelimb of Dicynodon, sp. nov. female individual. *Dr. D. H. Scott:* Sections of Upper Devonian plants showing structure. *Keeper of Geology, British Museum (Natural History):* Remains of a Palæolithic human skull and mandible, with flint implements and mammalian teeth, from a gravel at Piltdown, Fletching, Sussex. This collection was made by Mr. Charles Dawson, and is described by Messrs. Dawson and A. Smith Woodward in the Quarterly Journal of the Geological Society for March, 1913. The skull and mandible are regarded as representing a new genus and species of Hominidæ, named *Eoanthropus dawsoni*. *Prof. G. Elliot Smith:* The brain-cast obtained from the Piltdown skull, and other specimens for comparison. The cranial cast obtained from the Piltdown skull was shown alongside a series of specimens and drawings illustrating the form and constitution of the brain in primitive men, anthropoid apes, and other mammals supposed to be near the line of human ancestry. The objects of this comparative series are (1) to illustrate and help in the interpretation of the distinctive features of the most primitive human brain to which we have access at present, and (2) to elucidate the nature of the evolutionary process by which the human brain has been derived from that of an early mammal. A specimen was shown representing an attempt at the restoration of the features of the Piltdown man's brain. *Mr. Henry Balfour:* Stone implements of Early Palæolithic types from South Africa. A selected series of stone implements from South Africa, exhibiting marked similarity in form and technique to the Chellian and Acheulian implements of the Lower Pleistocene river-gravels of England and western Europe. The implements exhibited were collected partly in the neighbourhood of Kimberley and partly on the Zambezi (Victoria Falls) and the Maramba River. *Mr. C. Forster-Cooper:* Remains of fossil mammals from the Early Miocene deposits of Dera Bugti in Baluchistan. The bone beds around Dera Bugti are interesting from the fact that they contain the earliest remains of mammals as yet discovered in the East. From their situation on the probable line of migration from or to Europe and Africa, it is hoped that interesting comparisons may be made with the earlier or contemporaneous faunas of Europe and Africa. *Mr. H. Peake and Mr. E. A. Hooton:* Skulls and grave furniture from Saxon graveyard at East Shefford, Berks, explored 1912. This graveyard was discovered in 1890 during the construction of Lambourne Valley Railway. It was carefully explored in September, 1912, when twenty-six graves were found. It seems to date from the early part of the sixth century. *Prof. E. Hull:* Coloured map of the North Atlantic and bordering regions to show the submerged terraces and river valleys as determined by the soundings of the Admiralty charts.

NOTES.

The Bakerian lecture of the Royal Society will be delivered by Sir J. J. Thomson, O.M., F.R.S., on May 22, upon the subject of "Rays of Positive Electricity."

Dr. Gisbert Kapp, professor of electrical engineering in the University of Birmingham, has been appointed president of Section G (Engineering) of the British Association for the meeting to be held in Birmingham in September next.

The Georg Neumayer gold medal was bestowed upon Prof. L. A. Bauer, director of the department of terrestrial magnetism, Carnegie Institution of Washington, for his various researches in terrestrial magnetism, at the celebration of the eighty-fifth anniversary of the Berlin Gesellschaft für Erdkunde, on May 3.

The Newcastle City Council has decided to invite the British Association to meet in Newcastle in 1916. A deputation consisting of the Lord Mayor (Alderman J. F. Weidner), the Sheriff (Mr. G. T. de Loriol), and Sir W. H. Stephenson was appointed at the meeting of the council on May 7 to present the invitation at the meeting of the association in Birmingham next September.

The first Wilbur Wright memorial lecture will be delivered by Mr. Horace Darwin, F.R.S., at the Royal United Service Institution, Whitehall, on Wednesday, May 21, at 8.30 p.m., under the auspices of the Aëronautical Society, which has raised a fund for the annual delivery of a premium lecture in order to commemorate the work of Wilbur Wright, who, with his brother Orville Wright, evolved the first successful power-driven aëroplane which carried its pilot.

The Walker prize, which is awarded by the Boston Society of Natural History once in five years, has been awarded this year to Mr. Robert Ridgway, of the United States National Museum, in recognition of his investigations in ornithology, and particularly for his work on the birds of North and Middle America. This prize, the amount of which is 200*l*., was, says *Science*, founded by the late Mr. W. J. Walker, a benefactor of the society, and is given in recognition of important investigation in natural history published and made known in the United States of America.

The death is reported, in his seventy-eighth year, of Mr. W. M. Fontaine, a leading American authority in fossil botany. A Virginian by birth, tracing his descent from a Huguenot family, he fought on the Confederate side in the Civil War. He was afterwards professor of chemistry and geology at the West Virginia University, and later held the chair of geology and natural history at the University of Virginia for thirty-three years, retiring in 1911 with a Carnegie pension. Prof. Fontaine took part in the second Pennsylvania Geological Survey, and at various times contributed reports to the U.S. Geological Survey.

The latest ice reports contained in the meteorological chart of the North Atlantic Ocean for May, issued by the Deutsche Seewarte, state that in the vicinity of the Newfoundland Bank the drift ice, consisting of bergs and field ice, had greatly increased, and up to the third week in April had advanced southwards to nearly latitude 43° N., and eastwards to 41½° W. longitude. According to a report from St. John's (Newfoundland), at the end of March such a large amount of ice is seldom seen so early in the season. On the east coast of Cape Breton Island (Nova Scotia) much difficulty was caused to navigation. The conditions near Quebec had, however, much improved.

The fifth general meeting of the Alchemical Society was held on Friday last, May 9, at the International Club, Regent Street, S.W. The chair was occupied by the honorary president, Prof. J. Ferguson, professor of chemistry in the University of Glasgow, and a paper by the Ven. Dr. J. B. Craven, Archdeacon of Orkney, was read, entitled "A Scottish Alchemist of the Seventeenth Century: David, Lord Balcarres." The author has been permitted to examine what remains of Balcarres's library, and has found therein a MS. translation of the famous "Fama Fraternitas," antedating the earliest published translations. The paper also contained particulars of other interesting MSS. in this library, and concluded with an old Fifeshire legend showing the fantastic views which were once held concerning the Rosicrucians.

On Tuesday next, May 20, Prof. T. B. Wood will deliver the first of a course of three lectures at the Royal Institution on recent advances in the production and utilisation of wheat in England; on Thursday, May 22, Prof. W. J. Pope will begin a course of three lectures on recent chemical advances: (1) molecular architecture, (2) chemistry in space, (3) the structure of crystals; and on Saturday, May 24, Prof. Rutherford will commence a course of three lectures on radioactivity: (1) the α rays, (2) the origin of the β and γ rays, (3) the radio-active state of the earth and atmosphere. The Friday evening discourse on May 23 will be delivered by Prof. S. P. Thompson on the secret of the permanent magnet; on May 30 by Dr. Owen Seaman on parody; and on June 6 by Dr. Francis Ward on reflection and refraction of light as concealing and revealing factors in subaquatic life.

It is proposed to celebrate the centenary of the foundation of the Indian Museum in Calcutta next February. Originally founded as a branch of the Asiatic Society of Bengal at the suggestion of Wallich, the botanist, on February 2, 1814, the Indian Museum became a Government institution in 1867, after prolonged negotiations with the Government of India, which accepted the society's collections to form the nucleus of an imperial museum in Calcutta. A strong centenary committee has been formed with his Excellency, Lord Carmichael, the Governor of Bengal, as chairman, and Sir Asutosh Mookerjee, Vice-Chancellor of the Calcutta University, as vice-chairman. The committee has decided to publish an official history of the museum, to raise a special fund for the improvement of the public galleries, and to hold a reception in the museum on the anniversary of its foundation.

In connection with the Panama-Pacific International Exhibition to be held in San Francisco in 1915, a great display of horticulture is being arranged. The Horticultural Palace will provide an area of 207,000 sq. ft., and the building will be divided into three sections, namely tropical, semi-tropical, and temperate. In addition, about fifty acres will be reserved for outdoor nursery exhibits. The hall will be ready for the exhibits seven months before the opening of the exhibition, on February 20, 1915, and it is hoped that many of the plants will thus acquire the appearance of permanency before they are exposed to public inspection. In order to give extra novelty to the exhibition, the management offers a cup of the value of 1000 dollars for the best new seedling rose never previously exhibited. The rose which is awarded this prize will be named by the exhibition directors.

Under the title "Glorification de l'œuvre de Paul Schutzenberger," the *Revue Scientifique* of April 19 publishes a series of addresses delivered at the Ecole Municipale of Paris, on the occasion of the presentation to the city of Paris of a medallion, executed by M. Urbain, in commemoration of the life-work of the great chemist who was the organiser and first director of this famous school. Eulogies of Schutzenberger's purely scientific work were delivered by Profs. Haller, Noelting, and Matignon, whilst MM. Blondel, Lindet, and Scheurer dwelt on the very great influence he exerted on modern chemical industry by his investigations of the nature of dyes, and his discovery of hydrosulphurous acid and its application to indigo dyeing, which he effected in conjunction with M. de Lalande; the latter has within recent years led to the most important developments in the textile arts.

The fine collection of Indian big-game heads and horns left to the nation at the close of last summer by the late Mr. A. O. Hume has been placed on exhibition as a special series on the walls of the second floor of the central hall of the Natural History Museum, above and near the statue of Sir Joseph Banks. Immediately over the statue are displayed the skulls of gaur, yak, and buffalo, while those of wild sheep occupy the wall immediately to the right, and those of ibex, wild goats, and markhor the corresponding position on the left. On the extreme right flank are displayed the blackbuck, chiru, gazelle, and nilgai heads, while on the left flank are arranged the serow, tahr, and takin. The wall to the left of the entrance to the upper mammal gallery is occupied by the magnificent series of deer antlers, while a portion of the wall facing the one behind the statue has been assigned to a few heads of African antelopes included in the collection. The exhibit adds a striking and attractive feature to the museum.

The *Rassegna Contemporanea* (Anno vi., ser. ii., fasc. 6) contains an article on the date of the death of Christ by Pio Emanuelli. The Crucifixion took placed on the 14th day of Nisan, the first month of the Jewish year, and on a Friday. The month did not begin on the actual day of new moon, but on the evening when the thin sickle of the young moon was first perceived. The first problem to solve is therefore: How soon after the moment of new moon can the moon be seen? This has been investigated by Mr. J. K. Fotheringham, in the *Monthly Notices* for May, 1910, and by Mr. R. Courtenay, in *The Observatory* for June, 1911. The shortest possible interval after which the moon may be visible appears to be twenty-three hours, which, however, in certain circumstances may be considerably prolonged. Signor Emanuelli quotes these two papers, but does not give any particulars as to what he considers the smallest visible phase of the moon. He goes through the new moons nearest to the vernal equinox for the years A.D. 28 to 34 much in the same manner as done by Mr. Courtenay, and comes to the same result, that only A.D. 30, April 7, and A.D. 33, April 3, correspond to the 14th Nisan and also to a Friday. He decides for the year 30, as he says (without entering into explanations) that historical criticism excludes the year 33.

In the May issue of *Man* Mr. T. A. Joyce describes a fine gold beaker from Lambayeque, Peru, now in the collection of Mr. James Curle. The technique, representing a warrior with his shield, shows considerable skill. It is beaten out of a single sheet of metal, without any trace of a join. The outline is elegant and harmonious, and the lines of the design, in spite of its conventional nature, are bold and effective. It seems to belong to the period which immediately preceded the conquest of the coast by the Inca, a period of technical progress but artistic decadence.

In *The Scientific American* of April 19, Mr. E. J. Banks gives an interesting account of recent German excavations in Babylonia. Attention was principally directed to the mound at Babylon known as the Kasr. Babylon, after all, turns out to be a comparatively modern city as compared with those to the south. The expedition has discovered a black monolith brought in ancient times as a war trophy from the Hittite city of Karchemish. Dr. Koldewey's chief discovery is that of the palace of Nebuchadnezzar on the Kasr, of which practically only the foundations remain. At Amran, again, 40 ft. below the surface, he has found Esagil, the famous temple of Babylon. At Assur, Dr. Andrae and his successor, Dr. Maresh, have traced the city walls and several ancient palaces and temples. Excavation is now in progress at Erech or Warka, the home of the hero of the Gilgamish epic. Here discoveries of the greatest scientific interest may be expected.

An illustrated report (Research Bulletin 28) has been issued by the University of Wisconsin Agricultural Experiment Station on avian tuberculosis, the authors being Messrs. Hastings and Halpin. While not very frequent, the disease is of some economic importance. The authors were able to infect guinea-pigs, hogs, and rabbits with the avian, but were unable to infect hens with the human, tubercle bacillus. Suggestions are made for the elimination of the disease from the flocks.

In the Journal of the Washington Academy of Sciences for March 19 (vol. iii., No. 6), Messrs. Ayers and Johnson detail experiments on the destruction of bacteria in milk by the ultra-violet rays generated by a quartz mercury-vapour lamp. When the milk was exposed in thin layers to the rays, a marked reduction in the bacterial content was obtained, but the experiments indicate that it would not be possible to sterilise milk completely by the ultra-violet rays. In some cases an abnormal disagreeable flavour was produced by the rays.

THE Alpine Club of Canada has set a good example to kindred bodies by publishing in *The Canadian Alpine Journal*, 1912, lists of the mammals (by Mr. N. Hollister), birds (by Mr. J. H. Riley), and plants (by Mr. P. C. Standley) of the Mount Robson district, Mr. Hollister also giving a note on the reptiles and amphibians.

WE have received the first five numbers of a new journal (or work), entitled *Java, Zoologisch en Biologisch*, by Dr. J. C. Konigsberger, published at Buitenzorg, the first number being dated 1911, and the other four 1912. Its object is apparently to give a general popular account of the leading features of the meteorology and fauna of the island, the fauna being divided into a coastal fauna, the fauna of the plains, and the fauna of the high mountains.

A RESTORATION and model of the skeleton of the gigantic carnivorous dinosaur Tyrannosaurus, from the Montana Cretaceous, form the subject of an article by Prof. H. F. Osborn in the Bull. Amer. Mus. Nat. Hist., vol. xxxii., pp. 91–92. Another paper on reptilian palæontology is to be found in the Annals of the Transvaal Museum, vol. iv., pp. 1–46, where Dr. E. C. N. van Hoepen describes and figures in great detail a remarkably fine skull of the Karroo dicynodont *Lystrosaurus* (*olim Ptychognathus*) *latirostris*.

THE *Aarsberetning* for 1912 indicates that the naturalists of the Bergen Museum have been engaged in arranging exhibition series to illustrate the osteology of vertebrates in somewhat the same fashion as those displayed in the hall of our own Natural History Museum, photographs of the new exhibits being included in the report. The work of the biological station has also been conducted with the usual energy; pictures and plans of a new vessel and a map of the hydrographical stations in the neighbourhood of Bergen accompany the report.

WE have received from the Government of India copies of three Forest Bulletins (Nos. 13–15), by Mr. R. S. Pearson, dealing respectively with "ligno" as a means of protecting timber from splitting while seasoning, with the strength of natural and plantation-grown teak, and with the technical properties of toon wood (*Cedrela toona*), and giving evidence of the enterprise and activity of the Imperial Forest Service officers at the Dehra Dun Institute of Forest Research. In No. 13, the author describes briefly the methods employed for seasoning timber, and some experiments made with "ligno"—a light-brown plastic substance of the consistency of thick paint which has been placed on the market recently. The application of this protective substance is based on the principle of retarding evaporation from cut ends of logs and thus preventing splitting; the result of the severe tests applied was that "ligno" was found to be very effective in retarding the seasoning process, though not absolutely preventing splitting. In No. 14 details are given showing that plantation-grown teak is as strong as that from natural forests; the figures for compression and shearing tests show that the percentage of moisture in the timber has no marked effect on the strength of teak, whereas it has a considerable effect when transverse strain is applied across the fibre. In No. 15 details are given showing that toon timber, after contracting considerably during seasoning, is very liable to absorb moisture and expand again when seasoned, this process of contraction and expansion continuing for several years, though becoming less marked in successive years; hence in order to prevent this excellent furniture timber from falling into disrepute it is only necessary to allow a longer time for seasoning.

THE Meteorological Chart of the North Pacific Ocean for May, published by the U.S. Weather Bureau, contains the concluding part of several articles on cyclonic storms and typhoons of that ocean by Mr. W. E. Hurd. They constitute a very useful summary of the subject, compiled from available sources, including quotations from Father Algué's valuable report on the cyclones of the Far East, and track charts for various months. It is pointed out in the Barometer Manual issued by the Meteorological Committee that the tracks of tropical storms of the North Pacific are very similar to those of the North Atlantic. "Typhoons of the China Sea originate to the eastward of the Philippines, Carolines, and Ladrones. In the lower latitudes the centres travel westward. Some pass over the mainland, some recurve to the eastward, and eventually reach the west coast of North America by way of Japan." Near the Philippines the rate of translation is from six to twelve miles an hour, but in the vicinity of Japan the speed is greatly increased. Since the establishment of telegraphic communication between the Philippines and the outlying islands the warning of approaching storms is very efficient. The "barocyclonometer," invented at the Manila Observatory, "for ascertaining the position, distance, and direction of advance of a cyclone," is both ingenious and important; it is said to be in general use among East Indian vessels.

A PAMPHLET of "Suggestions for Investigations in Human Geography in Britain" has been written by Dr. H. J. Fleure and Mr. W. E. Whitehouse, and is issued from the registrar's office in the University College of Wales, Aberystwyth. It claims for "human geography, the part of the subject which deals with man's relation to his physical environment," the status of "the main objective of geographical study." The authors' ideals of detailed local investigation on these lines are lofty and exhaustive: a list of no fewer than eighty suggested "sections for investigation" is laid down, and many of them, such as those involving philological and antiquarian research, would demand a special training, quite outside that afforded by geography alone, for the investigator. No doubt, however, in such departments as these it is the authors' desire to impress the geographical point of view upon the specialists in other departments of knowledge. The geographical application of the authors' suggestions is not always clear—some of the details instanced in connection with fairs may serve as examples—and again, the geographer who attempts to take up such a topic as the "prehuman" condition of a given district is certainly liable to disappointment at the results obtainable. On these counts the impression may be felt that the writers of this pamphlet have spread their net too widely. They appear (and they are not alone) to forget their own definition of human geography, which has been quoted above. But if this be a fault it is far better than that of taking too narrow a view, and the pamphlet, criticism apart, must be regarded as profoundly suggestive, and as having been worked out with very great care.

A party of students, under the direction of Prof. K. Honda, made some interesting simultaneous observations at different stations during August, 1912, on the seiches of Lake Inawasiro (Japan). The lake, which is near the well-known volcano Bandai, is about 12 km. long and 10 km. wide, and has a mean depth of $51\frac{1}{2}$ metres. The limnimeters show that there were two oscillations of considerable amplitude with mean periods of 19·11 mins. and 8·89 mins., corresponding to the uninodal and binodal oscillations of the lake. A model of the lake was constructed, and the water in it was made to oscillate by means of a vibrating rod. The periods of the oscillations in the model correspond to periods of 19·53 and 9·11 minutes in the actual lake, while the forms of the nodal lines were clearly shown by means of aluminium powder with which the surface of the water was dusted.

A useful method of calculating the mean variation by the aid of a calculating machine is given by Prof. Knight Dunlap in the current number of *The Psychological Review*. If in a given series of N terms, with average M, P terms be greater and R terms be less than the average, then the mean variation may be calculated from either of the two formulæ,

$$\frac{\Sigma P - P.N}{\frac{N}{2}} \quad \text{or} \quad \frac{R.M - \Sigma R}{\frac{N}{2}}$$

"By the use of the calculating machine, great accuracy may be obtained with the minimal expenditure of time and energy," if such methods as the above are followed, which dispense with the numerous subtractions of the older method.

From the report of the joint committee appointed by the Institution of Electrical Engineers, the Institution of Gas Engineers, the Institution of Municipal and County Engineers, and the Illuminating Engineering Society, on street lighting, with which Mr. Trotter opened the discussion of the subject at the last meeting of the Illuminating Engineers, and from the reports of the discussion which have appeared in the technical Press, it seems possible that the measurement of the minimum illumination of a plane 39 in. above the ground will eventually be accepted as the criterion of good or bad lighting of a street. The classification proposed by the committee is as follows:—Class A, minimum 0·01; B, 0·025, C, 0·04; D, 0·6; E, 0·10 foot-candle.

When a curve is drawn in the ordinary way to represent the effect of light upon a photographic plate, the part of it that represents the effect of the shortest exposures is exceptional in that it shows a gradation that is less steep than the part that follows it, and gradually approximates to it. This exceptional part was called by Messrs. Hurter and Driffield the "period of under-exposure," and plate-makers were advised to reduce it as much as possible, and photographers to avoid it. But this "period" cannot be eliminated, and therefore in practical work it remains, as it always has been, of very great importance, although Messrs. Hurter and Driffield dismissed it with but little consideration. After an interval of more than twenty years, Mr. F. F. Renwick, of Ilford, Ltd., has taken up the study of this particular period, and in the April number of the Journal of the Royal Photographic Society there is published a paper upon it that he recently communicated to the society. Mr. Renwick finds that the "under-exposure period" is not so disadvantageous as some theoreticians have endeavoured to prove it to be, and to a certain extent he justifies the practical workers who utilise it to the utmost. He shows the nature of this part of the density curve in many various plates and printing papers, giving full details, and points out that as the curve in printing papers is of the same general character as that in the negative, the gradation error of the latter is, more or less, compensated in printing.

To the *Revue générale des Sciences* of March 30 M. Ch. Maurain contributes an article on "Les Etudes d'Aérotechnique à l'Institut de St. Cyr." The recently founded aëronautical laboratory at St. Cyr differs fundamentally in its methods from that of almost all other existing institutions for aëronautical research, and its apparatus is designed for the purpose of "approaching as closely as possible to the practical conditions of aërial locomotion." By this is meant scientific experimental research on full-scale models at full speeds, and some work of a preliminary character on wing surfaces has already been accomplished. The work is being extended to experiments on large propellers, and provision is being made for the construction of a measuring apparatus sufficiently strong to be able to carry a complete aëroplane. The apparatus is mostly out in the open, and consists essentially of a track more than three-quarters of a mile in length, along which electrically-driven carriages can be run at speeds up to fifty miles per hour. The measuring apparatus is attached to the carriage, and during the eight or ten seconds in which the speed is maintained constant the forces and couples on the model under test are automatically recorded. Concurrently with these experiments, measurements are being obtained on aëroplanes in flight, and on small models held in a current of air. The latter experiments on small-scale models are expected to give information as to the conversion factors for scale which may become important as the science of aviation develops.

Red Book No. 173 of the British Fire Prevention Committee contains an account, with photographs, of tests on reinforced concrete doors. These doors were constructed to the designs of Commandant Welsch, ex-chief officer of the Ghent Fire Brigade. No. 1 door had a T iron rim and expanded metal and flat-iron reinforcement filled in with concrete; this door was hung on runners and made to slide, and was fixed on the outside of an opening. No. 2 door was similar to No. 1 door, but fixed on the inside of an opening. In No. 3 test two doors as described above were used, one on the inside and one on the outside of an opening. In No. 3 test, the doors were subjected to the action of a fire of 150 minutes' duration at temperatures gradually increasing to about 2000° F., followed by the application of water for two minutes on the fire side. In thirty-two minutes the outer face of the outer door was too hot to bear the hand, and in 140 minutes the lower half of the door had bulged outwards. In seventeen minutes cracks appeared all over the fire side of the inner door and continued to increase; in 107 minutes this door came away from the runner at one top corner; in 150 minutes the door fell forwards into the interior of the hut. On water being applied, the inner face of the outer door was eroded where struck by the jet. The tests afford some very useful lessons and give information which should lead to the design of an efficient fireproof reinforced concrete door.

The report of the council and the proceedings of the Hampstead Scientific Society for the year 1912 show that the work of the society, which was founded in 1899, not only expanded greatly during the year, but increased in value. It is hoped that during the present month the work "Hampstead Heath: its Geology and Natural History," prepared by members of the society, will be published. The Mayor and Borough Council of Hampstead have invited the South-Eastern Union of Scientific Societies to hold its annual congress at Hampstead this summer, and the meetings will be held from June 4 to 7. Thirty-two meetings were held during the year, besides six summer outdoor meetings and a course of four lectures to juveniles during the Christmas holidays. Among the list of lecturers during the year we notice the names of the president of the society, Prof. W. M. Flinders Petrie, and of Profs. A. Fowler and A. W. Porter. The report records a deficit on the general working of the society, due to the heavy expenditure involved in the maintenance of the meteorological station, which has now three years of unbroken meteorological records to its credit.

Among the most recent additions to the admirable series of "The People's Books," which Messrs. T. C. and E. C. Jack are publishing at 6*d*. net each, are three volumes dealing with subjects of science and technology. Dr. P. Phillips writes on the "Science of Light," and intends his book to be a companion to that on "Radiation," already published in the series. In between eighty and ninety small pages he deals with the propagation, reflection, refraction, dispersion, interference, and polarisation of light, and also explains diffraction and the electromagnetic nature of light waves. The treatment is necessarily slight, but the volume will prove useful even to students of physics, because of the outline history of the science which it contains. In a volume on "British Birds," Mr. F. B. Kirkman gives descriptions of 187 of the commoner species and their nests and eggs. Mr. A. W. Seaby has provided 111 illustrations, which, though small, give a good idea of the birds described. The third book is on "Gardening," and is by Mr. A. C. Bartlett, who has confined his attention to descriptions of the chief gardening operations and the propagation of plants by cuttings, grafting, budding, and other methods.

OUR ASTRONOMICAL COLUMN.

A New Faint Comet (1913*a*).—A Kiel telegram of date May 7 reports the discovery of a comet of magnitude 9·5 on May 6, at 15h. 5m. mean time, Nice, by M. Schaumasse, of the Nice Observatory. Its position when discovered was given as R.A. 20h. 54m. 44s., and declination $+9° 52'$, and it was moving in a north-easterly direction.

A Kiel circular of May 10 gives the following elements and ephemeris, computed by Kiess and Nicholson:—

$$T = \text{May } 17{\cdot}91 \text{ G.M.T.}$$
$$\omega = 57° \ 28'$$
$$\Omega = 317° \ 0'$$
$$i = 26° \ 26'$$
$$q = 1{\cdot}440$$

	α (h. m. s.)	δ (° ′)
May 15 ...	20 16 12 ...	+19 0
,, 19 ...	19 48 37 ...	+24 13
,, 23 ...	19 11 22 ...	+30 7

The comet rises this evening about 9.20, and should be capable of being seen with telescopes of moderate power in the early morning hours.

The Physical Appearance of Mars.—It is well known that observers of the planet Mars are divided into two schools, one believing that the so-called canals are really long, continuous, and narrow streaks, the other looking upon them as the summation of a complexity of detail revealing irregular streaks and presenting frequent interruptions and condensations. In the current number of *Knowledge*, Mr. Antoniadi, a strong advocate of the latter view, communicates an interesting article on the subject of these Martian markings, and puts forward his explanation of the divergency of ideas of observers on their appearance. Large *versus* small aperture is his main reason; thus he writes:—"The student who passes many consecutive hours in the study of Mars with medium-sized instruments is liable to catch rare glimpses of straight lines, single or double, generally lasting about one-quarter of a second. Here we have a vindication of Schiaparelli's discoveries. But their deceitful character will obtrude itself on the observer using a large telescope, when, in the place of lines, he will behold steadily either a winding, knotted, irregular band, or the jagged edge of a half-tone, or some other complex detail." The article is illustrated by a fine set of drawings of the planet made in 1911, the observations being made with the 33-in. refractor of the Meudon Observatory.

The National Observatory of Athens.—Vol. vi. of the *Annales de l'Observatoire National d'Athènes* contains a series of valuable contributions published under the direction of Prof. Demetrius Eginitis, the director of the observatory. It is only possible here to state the titles of the memoirs and sets of observations, as the volume covers more than 300 pages, and is illustrated with numerous plates. The memoirs deal with Halley's comet during its last return; observations of the major planets; Nova Lacertæ; the earthquake in the Gulf of Corinth on May 30, 1909; and, finally, with the study of seismic disturbances in Greece during the years 1909–11. The second portion of the volume deals with observations for the same period, and these include equatorial and meridional observations, meteorological observations made at the observatory and at departmental stations, and, lastly, a catalogue of earthquakes observed in Greece during the same year.

Frequency of Prominences on Eastern and Western Limbs of the Sun.—Mr. Evershed has examined statistically a mass of very complete material of prominence observations, both visual and photographic, to inquire into the question as to whether one limb is more prolific than the other (Kodaikanal Observatory Bulletin No. 28). In his examination he has gone thoroughly into the question of the methods of observation for both kinds of records in order to make certain that the results were in no way affected by any kind of systematic bias in favour of one limb over the other.

The result of the inquiry is that there is a distinct predominance of frequency at the eastern limb. Briefly summarised, the different records led him to the following conclusions. The Kodaikanal observations for 1904–11 displayed as regards numbers for each year a nearly constant excess of east over west, the average percentage of east being 52·70. The Kenley and Catania series for 1894–1905 exhibited also an eastern excess averaging 50·8 per cent of the whole number recorded; for the period 1906–11 the Catania observations displayed an eastern excess of 54·26 per cent. At Kodaikanal during 1905–11 the larger prominences showed a smaller eastern excess than the smaller prominences, the percentages being 51·16 and 53·60 respectively. In the case of profile areas of prominences a small average excess of eastern areas is observed. The eastern excess as regards numbers is about the same for prominences in equatorial regions up to 30·5° lat. as for those in higher latitudes.

Mr. Evershed directs attention to a slight evidence of planetary action similar in effect to that of the earth in the case of Venus only among the major planets, and also to an annual periodicity in the eastern predominance with maxima in January and August and minima in April and November. In a supplementary note he points out that metallic prominences and those showing displacements of the hydrogen lines show a much greater preponderance of east over west, the percentages in these cases being 59·9 and 57 respectively. As all the observations were made visually there is the possibility of bias in favour of the eastern limb.

EVENING EDUCATIONAL WORK IN LONDON.[1]

A VERY valuable and interesting survey of the progress of technical, scientific, and commercial education in evening classes in the London polytechnics, technical institutes, and continuation schools has recently been presented to the Education Committee of the London County Council by Mr. R. Blair, the education officer of the council.

The provision now made of instruction in evening classes in London is of remarkable range and extent. It comprises tuition, at almost nominal fees, in all stages of science, technology, arts and crafts, commercial subjects, economics, and literature, in well-equipped institutions from qualified teachers. The London evening student has now far greater educational facilities open to him than are offered in even the most progressive provincial towns, especially in the matter of securing university recognition for his work, if of a sufficiently high standard.

Some idea of the magnitude, the complexity and the importance of the educational work carried on in evening classes in London is given in the following numbers taken from the report:—

The approximate number of evening students enrolled in 1910–11 was as follows (p. 60):—

(1) In the polytechnics	25,000
(2) In technical institutes and schools of art maintained by the L.C.C.	10,000
(3) In commercial centres	30,000
(4) In ordinary evening schools	100,000
(5) In other institutions, settlements, &c. (estimated)	30,000
	195,000

Deducting one-third of this number as "ineffective" students through irregular attendance, &c., it is clear that a large amount of intellectual and educational work is being steadily carried on, which must of necessity play an important part in the economic and social development of the people of London.

A curious fact is the increasing proportion of adult students, *i.e.* above twenty-one years of age, in attendance at evening classes. In 1910–11 the probable number of such students was 80,000, "more than twice the number of pupils of all kinds in all the public secondary schools of London."

The gross annual cost of maintenance of evening teaching in London may be approximately estimated at 400,000*l.*, of which about one-half is expended by the polytechnics and the technical schools.

Illustrations are given on p. 12 of the report of the direct value of the work of London technical institutions to the local industries, especially the Leathersellers' College at Bermondsey in its relation to tanning, the Northampton Institute at Clerkenwell to the optical industries, and the L.C.C. School of Photo-engraving and Lithography with respect to the "three-colour" process. In addition to their industrial and technical work, a considerable amount of purely scientific research emanates from the London polytechnics each year, an excellent account of this branch of their activities being given in pages 42 to 47 of the report.

In a memorandum by Mr. A. E. Briscoe (divisional inspector) upon the "Polytechnics and Technical Institutes," it is stated:—"A good deal of very uninformed criticism is directed against instruction in evening classes; it is often urged that such work cannot be effective; that attendance must be irregular; that students are frequently too tired physically and mentally to make the best use of the time available, and that they are also ill-prepared by their previous education. There is some truth in these contentions, but those who urge them . . . their views would be materially altered if they would but spend a week in a close inspection of the work that is actually done. . . . The first thing that would strike them would be the eagerness to learn. . . . The evening student has less time for study, but he makes more effective use of it. He has practical knowledge that forms an excellent basis. . . . In many institutions evening students are doing work in their subjects quite equal to that required for a university degree."

[1] Report on Eight Years of Technical Education and Continuation Schools (mostly evening work). Presented to the Education Committee on December 11, 1912, and ordered to be printed. London County Conucil Education Committee: P. S. King & Sons. Price 2*s.* 6*d.*

In finally summarising the position of evening education in London, Mr. Blair concludes with the following passage (p. 24):—"A large increase of students in higher institutions, a large extension of premises and improved equipment, a large increase all over in attendance hours per student . . . an increased representation of masters and workmen on advisory committees, with a corresponding increase in the interest of employers, and of expert criticism of work done, all support the view that the period 1904–12 has been characterised by great expansion in quantity and quality of work."

Since the publication of the report referred to above the education committee of the council has decided upon a comprehensive scheme of reorganisation of the evening continuation schools, which are in future to be termed "institutes" instead of "schools." The main features of the scheme are the specialisation of the functions of individual schools depending upon the social, educational, and industrial demands of the respective districts, the appointment of a number of "responsible masters" for evening work only, the increased provision of non-vocational education, and definite coordination with higher institutions, such as the polytechnics. It is mainly in respect to the last point that the organisation of London evening education has compared very unfavourably of recent years with the organisation in a number of provincial towns.

The junior technical institutes will be definitely linked up in future with the neighbouring polytechnic. The principal (or head of department) of the higher institution will have the right to visit the junior institute in an advisory capacity, and to offer advice upon the appointment of the staff and upon the framing of courses and syllabuses. Standing local committees will be formed consisting of the principal and heads of departments of the polytechnic and "responsible masters" of the junior institutes, in order to cement the relationship between the two types of institutions.

The new scheme as a whole is thoroughly sound, and, if carried out, as there is every reason to expect will be the case, it will undoubtedly have far-reaching, beneficial effects upon London education.

J. WILSON.

LAW OF THE PAY-STREAK IN PLACER DEPOSITS.[1]

EXPLANATIONS of the eccentricities of the pay-streak in placer deposits have long been considered difficult to furnish. Geikie, Beck, Posepny, Locke, Lindgren, and many others have all discussed the subject and acknowledged the fact. Eight years' residence and study of placer phenomena in the Klondike gold-bearing region of Canada on the part of Mr. J. B. Tyrrell have enabled him to formulate a natural law respecting the location of the pay-streak, not only in the Klondike, but also in any placer region of the world.

An accurate knowledge of the structure and growth of a valley, comprising the different phases of its history in detail, always presents geological facts and deductions capable of broad and general application, and these are generally recognisable without great difficulty. After considering the nature and rate of erosion and sedimentation in a given valley under normal stream action, the formation of a V-shaped valley and its transformation into a U-shaped one, and the presence of flood-plains and terraces, the laws governing the formation and position of the pay-streak in an alluvial plain in the bottom of a valley may be stated as follows:—

(1) It was formed in the bottom and at the mouth of the V-shaped valley which was the young representative of the present valley.

(2) It marks the position formerly occupied by the bottom of that V-shaped valley.

(3) The gold contained in it was washed out of the surrounding country and collected into approximately its present position before the gravel of the flood-plain (or terrace) was deposited over and around it.

The practical application of this discovery of identifying nature's way of hydraulicing and storing the gold in the bottoms of the valleys must be welcome to all economic geologists and mining engineers.

Mr. Tyrrell holds that some 30,000,000*l*. of gold has been recovered to date from the Klondike region, and that an equal amount no doubt remains to be extracted. Some 900 ft. thick of rock-formations have been removed from the Klondike country, and 130 cubic miles of gravel scattered over the 800 square miles of placer deposits, making only one-hundredth of a pennyworth of gold per ton of original rock concentrated by nature.

H. M. A.

[1] "The Laws of the Pay-streak in Placer Deposits." By J. B. Tyrrell. Trans. Inst. Min. and Metallurgy, pp. 593–605. (London, 1912.)

THE UPPER AIR DURING FÖHN.

DR. H. VON FICKER has made notable additions to our knowledge of Föhn by his contributions on this subject to the Transactions of the Vienna Academy. His researches showed that the Alpine Föhn is the local manifestation of an extensive phenomenon which is revealed almost simultaneously in places of the same altitude over a large region. In a paper in the *Sitzungsberichte* of the Vienna Academy, May, 1912, he describes observations on Föhn during three balloon ascents from Innsbruck in 1910 and 1911. It was found impossible to make ascents at the time of actual Föhn at the surface owing to the very gusty character of this wind. In one ascent only was the balloon over the mountains at the time of Föhn, and then it was the plaything of the vertical currents, which, however, were kind enough to spare the balloonists actual disaster. At one time the balloon was carried downwards 900 m. and up again 1100 m. in the course of five minutes, indicating vertical currents of five metres per second or more. Such information is clearly of importance to aviators, apart from its bearing on the elucidation of the meteorological phenomenon.

The general conclusions of von Ficker are that before the outbreak of Föhn at the surface, it is blowing over the cold air in the valleys and plains, the surface of separation between the two currents being frequently marked by strato-cumulus cloud. When the Föhn current crosses the ridges and valleys at right angles it descends on the lee side and ascends on the windward side, with a partial clearing of the cloud in the region of descending air. Föhn is usually dissipated by the coming of a north-west wind, the change probably being of the nature of a line-squall. The vertical temperature gradient during Föhn was usually less than the adiabatic gradient for dry air, except when the balloon was carried up and down in the vertical currents, but it was greater than the normal gradient. The change of wind direction with altitude was normal, the south-east wind of the lower layers changing to south and south-west winds at higher levels up to 3–4 km. The value of the discussion is enhanced by the results of ascents at Munich and observations at Zugspitze (3000 m.) which the author was able to incorporate by the courtesy of Dr. Schmauss, who is keenly enthusiastic about all upper-air investigation.

E. GOLD.

ACTIVE NITROGEN.[1]

EVERYONE has heard of ozone, the active modification of oxygen which is produced when this gas is subjected to electric discharge. I hope to show you to-night that nitrogen can also be made to assume an active state under suitable experimental conditions. We will begin with an experiment (Fig. 1) which will serve to introduce the subject.

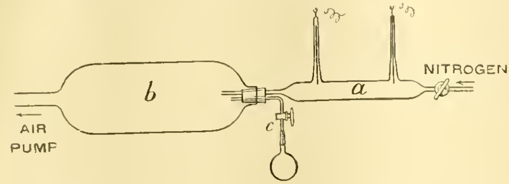


FIG. 1.

A rapid stream of rarefied nitrogen gas passes through the tube *a* at a pressure of a few mm. of mercury, and on its way the gas is sparked through by a series of high-tension electric discharges from a Leyden jar. It then issues as a jet into the large vessel *b*, where it is seen to be brilliantly luminous, the stream of gas being visible as a whirling cloud of brilliant yellow light. Notice that this light is of a different colour from that of the electric discharge in the former vessel.

Why does the gas remain luminous in this way for an appreciable time after the electric discharge has passed through it? The view which I shall develop this evening is that the discharge has split the nitrogen molecules into single atoms. Nitrogen atoms in this condition are uneasy, and are anxious to find partners again. But to do this takes time. The reunion of the nitrogen atoms is attended with the emission of the yellow light which you see, and this continues so long as the process of pairing off is incomplete.

Preliminary even to considering this theory, we must be certain that nothing but nitrogen is necessary to the success of the experiment, and that no other substance intervenes. Some experimenters in Germany have recently expressed the opinion that traces of oxygen are concerned. I am satisfied, however, that they are entirely mistaken. The nitrogen used in the experiment you have just seen has been standing in contact with phosphorus until the phosphorus no longer glows in the dark. If I added a 1/100,000th part of oxygen to the nitrogen, the phosphorus would begin glowing again quite perceptibly. So we may be sure that there is not that amount of oxygen present: and I do not think it is reasonable to attribute these brilliant effects to a smaller amount. Again, we may inquire what is the effect of adding oxygen intentionally? I find that the addition of 2 per cent. of oxygen is enough to obliterate the phenomena altogether. Much more might be said on the subject, but we must pass on.

It is convenient for some purposes to experiment in a different way. We have here two similar glass globes containing rarefied nitrogen. I can induce an electric discharge in them without electrodes by putting them in this coil of wire, through which a Leyden jar is constantly discharging. When I withdraw them you see that they are brilliantly luminous, and that they remain so for several minutes after stimulation. By holding them alternately in the exciting coil we can get them about equally bright, and you see that the luminosity of each decays at about the same rate. Now I stimulate them equally again, and cool one down by immersing it in liquid air. It shines brightly for a moment, but soon becomes quenched. I withdraw it, and you can compare it with the other, which is still brightly luminous.

This experiment shows that cooling the gas shortens the period of luminosity. Let me show you next that the brilliance is increased by cooling. I have exhausted this bulb to a suitable degree, and cool the neck by immersion in liquid air, contained in a transparent vessel (Fig. 2). You see how much brighter the cooled portion is after excitation than the rest of the bulb. There is no doubt a certain ambiguity in this form of experiment, because cooling a portion of the vessel causes a local concentration of the gas in that portion. I must ask you to take it from me that special experiments have proved that this cause is not enough to explain the greatly increased brightness you have seen. The reunion of nitrogen atoms occurs, then, more quickly the lower the temperature. This is a unique instance of a chemical action being quickened by cooling. In all other cases heating accelerates the action. Plausible objections may be made to this statement, but I must content myself now with saying that they admit of answer.

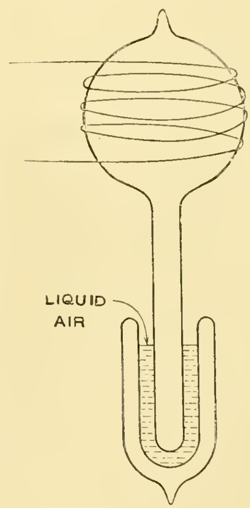


FIG. 2.

When oxygen and hydrogen unite, the union may occur in two distinct ways. It may occur with luminosity throughout the volume of the mixture, as when the gases are exploded, or, again, it may occur at the surface of a solid such as clean platinum. In the latter case there is no luminosity.

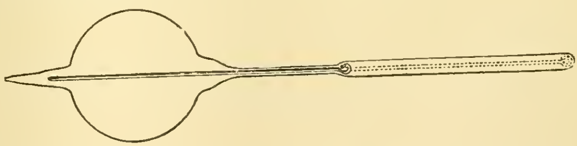


FIG. 3.

Similarly, active nitrogen atoms may reunite in the volume of the gas with luminosity—this we have seen already—or the combination may occur without luminosity at a suitable surface. Oxidised copper

[1] Discourse delivered at the Royal Institution on Friday, February 28, by the Hon. R. J. Strutt, F.R.S.

affords such a surface. This bulb (Fig. 3) can be made to glow like those you have seen before, by inserting it into a coil; and if the copper wire is situated in the side tube the glow lasts a long time, for the gas has as yet no access to it. But if I excite the gas again, and turn the bulb round so as to drop the oxidised wire into it, you see that the luminosity is extinguished in a fraction of a second. Combination of the nitrogen atoms occurs much more quickly at the surface, so that the whole quantity of active nitrogen present is almost instantly used up. Incidentally, the experiment illustrates the extremely rapid diffusion of the gaseous residuum in an exhausted vessel, for every particle of the active nitrogen must evidently find its way to the surface of the wire in the fraction of a second.

We pass now to consider the effect of nitrogen in this condition on other substances. The yellow glow we have studied so far is due to the recombination of nitrogen atoms, and accordingly it shows a nitrogen spectrum, though with very curious modifications.

If we offer to the monatomic nitrogen other substances, it will often unite chemically with them, which, of course, cold ordinary nitrogen will not do. I go back to the apparatus used in the first experiment, and admit some acetylene by a stopcock (*c*, Fig. 1). The jet of active nitrogen now enters an atmosphere of acetylene, and you see that the character of the light is at once changed; it has become lilac. I turn off the acetylene and substitute chloroform vapour. We now get an orange light. This may appear very different, but the difference is unessential. The spectrum is in each case that characteristic of cyanogen and its compounds, only the violet portion of this spectrum is more intense with acetylene, the red portion with chloroform.

Since we get the cyanogen spectrum without having any cyanogen compound originally present, we may suspect that some such compound has been formed. Let us pass from suspicion to proof. Using chloroform vapour from a bulb containing the liquid (see Fig. 1), we pass the gases through a vessel in which a test-tube is inserted. This test-tube contains liquid air, and any condensable constituent is frozen out on to its external surface (Fig. 4). After a few minutes' run, we take out the test-tube and dip it in a solution of potash. I now add a mixture of ferrous and ferric salts and excess of hydrochloric acid. I pour out the liquid on to this white porcelain dish, and you see that abundance of prussian blue has been formed. This proves the presence of some cyanogen compound.

We can get the same result with pentane, ether, benzene, or almost any other organic vapour. With these the amount of cyanogen formed is much the same, but the cyanogen spectrum, curiously enough, is far less conspicuous. Benzene, for instance, almost quenches the nitrogen glow, and little can be seen of the cyanogen spectrum either. In most cases it appears that hydrocyanic acid is formed, but the orange cyanogen glow, only obtained in compounds containing much chlorine, is probably due to the formation of chloride of cyanogen in addition. This, when absorbed in potash, forms a cyanate, which has been detected chemically.

In the case just considered, the spectrum observed, when active nitrogen is mixed with another substance, is that of the product of the action. In some cases, however, the spectrum developed is that of the substance originally introduced. I admit some of the vapour of perchloride of tin: you see the brilliant blue glow. I introduce a drop of the liquid chloride on a wire loop into the flame of a Bunsen burner, and you see the same blue colour, though less advantageously. The brilliance of the luminous effect does not seem to give any trustworthy indication as to whether much chemical action is going on. If, for instance, we admit bisulphide of carbon vapour to the active nitrogen stream, we do not get very brilliant effects of luminosity—nothing striking enough to be worth showing you—but none the less interesting chemical actions are going on. The tube in which the action occurs gets covered with the dark blue transparent deposit, which I show by projection on the screen. This substance is a known compound of nitrogen and sulphur, originally investigated by Mr. Burt in 1910. If the gases are condensed farther on in the tube by liquid air, we get a second deposit of brown colour, which can be identified as the brown polymeric carbon monosulphide studied by Sir James Dewar and the late Dr. H. O. Jones. You see, then, that the chemical action is completely traced. Active nitrogen takes part of the sulphur from carbon disulphide, leaving carbon monosulphide.

The behaviour of active nitrogen with metallic vapours is of interest, though it has not yet been very

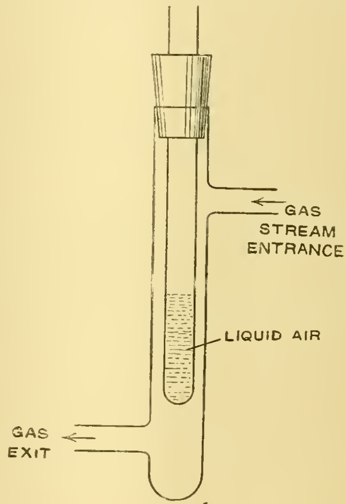


FIG. 4.

completely studied. I select the case of mercury to show you. We pass the stream of glowing gas through this tube, which contains a small pool of mercury. While the mercury is cold, the yellow glow passes on unaffected. I apply heat, and green mercury light, of the colour familiar in the mercury-vapour lamps used in electric lighting, is apparent, when active nitrogen mingles with mercury vapour. Soon the tube gets obscured, except when I am actually heating it, by a dirty-looking solid deposit containing much metallic mercury.

I wish to convince you that an explosive compound of nitrogen and mercury has been formed. For this purpose, to save the trouble of dismounting the tube already used, we will take a similar one prepared beforehand. I heat the mercurial deposit moderately over a Bunsen burner, and, if you will kindly be quite still for a moment, we shall hear a distinct crackling sound, as the explosive compound decomposes. At close quarters it is easy to see flashes of light accompanying the minute explosions, but these can scarcely be shown to an audience, as the opaque deposit over the greater part of the tube obscures them.

It has only been possible this evening to bring forward a selection of the results of two years' work on this subject at the Imperial College, with generous help from colleagues, and facilities provided by the governors.

Let me conclude by reading to you a prophetic passage from one of Faraday's letters to Schönbein :—"What of nitrogen? Is not its apparent quiet simplicity of action all a sham? Not a sham, indeed, but still not the only state in which it can exist. If the compounds which a body can form, show something of the state and powers it may have when isolated, then what should nitrogen be in its separate state? You see I do not work; I cannot. But I fancy, and stuff my letters with such fancies (not a fit return) to you."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A NEW chair of bacteriology is to be founded in Edinburgh University under a bequest from Mr. Robert Irvine, of Royston, Granton. At his death, eleven years ago, Mr. Irvine bequeathed 230 shares of 10*l*. each in a company for developing the resources of Christmas Island for the purpose of establishing the chair when the interest from the shares should reach 25,000*l*. or 30,000*l*. The accumulated dividends on these shares now reach more than 30,000*l*. It is understood that 25,000*l*. will go towards the maintenance of the professorship, and that the remaining 5000*l*. will be used in providing the class-rooms, laboratories, and the necessary equipment.

ATTENTION has already been directed to the progress which has been made in the provision of well-equipped laboratories for the study of electrical technology and kindred subjects in the University of Hong Kong. Prof. C. A. Middleton Smith has sent us an exhaustive list of engineering and other equipment which has been presented to the University by public-spirited manufacturing firms. Their generous support of the cause of higher technical education in the distant parts of the Empire is sure to be productive of excellent results, and is worthy of emulation by other firms. The greatest support seems to have been received for the department of heat engines, and the authorities in Hong Kong hope that more offers of apparatus will be received from firms interested in electrical engineering. A complete equipment is required for experiments in all branches of electrical work, and an appeal is made to manufacturers that this branch of engineering shall be represented worthily in the equipment presented to the University. It is impossible here to mention each of the gifts which have been made, but as indicative of the substantial character of the gifts, the complete spectrographic outfit presented by Messrs. Adam Hilger and Co., and the Sankey's hand-bending testing machine given by Mr. Casella, may be mentioned.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, April 25.—Prof. C. H. Lees, F.R.S., vice-president, in the chair.—W. R. **Bower** : A graphical method of optical imagery. The paper contains a development of optical imagery based on elementary geometry, including limiting positions, but excluding cross-ratios, centres of perspective, &c. The method adopted is useful for teaching the properties of optical systems to those who are not essentially students of pure mathematics, and can be satisfactorily used by those capable of draughtsmanship with mathematical instruments.—Dr. C. V. **Burton** : The spectroscopic resolution of an arbitrary function. An ordinary grating has periodic rulings, and a spectrum obtained by means of it is characteristic of the radiation entering the spectroscope-slit. But if the radiation is homogeneous, while the distribution of the rulings is arbitrary, we obtain a spectrum characteristic of the grating. It is thus found to be theoretically possible to resolve spectroscopically a given arbitrary function $\phi(x)$ into its harmonic constituents. The theory of the proposed method of resolving functions is discussed, and is as complete as that of ordinary spectroscopy, while in one respect it is more simple; for, since the light entering the spectroscope-slit is entirely of one wave-length, the comparison of intensities of spectral lines (whether visually or photographically) is facilitated.

Linnean Society, May 1.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Prof. P. **Groom** and W. **Rushton** : The structure of the wood of East Indian species of Pinus.—Dr. Winifred **Brenchley** : Branching specimens of *Lyginodendron oldhamium*, Will.—A. C. F. **Morgan** : A problem in Weismannism.—Mrs. L. J. **Wilsmore** : *Sphenopus marsupialis*.—Papers on collections made by the Percy Sladen expedition to the Indian Ocean :—Miss Helen L. M. **Pixell** : Polychæta of the Indian Ocean, with some species from the Cape Verde Islands. The Serpulidæ, with a classification of the genera Hydroides and Eupomatus.—S. **Hirst** : Report on the Arachnida of the Seychelles.—Miss Marjorie **Lindsay** : *Gypsina plana*, Carter.—A. **Grouvelle** : Nitidulæ, Heterocidæ.—A. **Raffray** : Pselaphidæ de l'Archipel des Seychelles.—Dr. K. **Jordan** : Anthribidæ of the Seychelles.—S. **Maulik** : Hispinæ from the Seychelles.—Dr. K. **Jordan** : Certain changes in nomenclature of Lepidoptera proposed by Dr. Verity.

Zoological Society, May 6.—Dr. Henry Woodward, F.R.S. vice-president, in the chair.—Dr. F. E. **Beddard** : The anatomy and systematic arrangement of the Cestoidea. This paper, the tenth of the series, contained an account of two species of tapeworms found in a Dongolan genet, both of which were described as new, one being made the type of a new genus.—J. A. **Milne** : Pacific salmon : an attempt to evolve something of their history from an examination of their scales. Reasoning from the similarity of their appearance to the scales of the other Salmonidæ, the author pointed out that all the migratory species except *Onchorhynchus kita* remain for at least a year in fresh water before proceeding to the sea—in the Fraser River district, at any rate. He also showed the scale of a quinnat, and pointed out that it was scarcely possible to avoid the conclusion that that fish had already spawned once before it was captured.—Miss Kathleen **Haddon** : Notes on *Peripatoides woodwardii*, Bouvier. This paper was based on material collected in Western Australia, consisting of twenty specimens, male and female, ranging in size from 17 to 46 mm., thus considerably exceeding in length those described by Prof. Bouvier. Various types of coloration are exemplified, some being blue-green with small yellow spots, while others have the yellow pigment increased so as to give a tawny appearance to the animal; a dark variety of this latter type also occurs.—J. C. F. **Fryer** : Field-observations on the enemies of butterflies in Ceylon. It was concluded (1) that in Ceylon, with the exception of the wood-swallow, birds are not formidable enemies to butterflies; (2) that owing to the propensity of the wood-swallow for members of the genera Danais and Euplœa, a resemblance to them would be not a safeguard but a danger.

Mathematical Society, May 8.—Prof. A. E. H. Love, president, in the chair.—Prof. W. **Burnside**: Some properties of groups the orders of which are powers of primes. Prof. H. S. **Carslaw**: The Green's function for the equation $\nabla^2 u + k^2 u = 0$.—Prof. W. H. **Young**: The usual convergence of a class of trigonometrical series.—W. F. **Sheppard**: (1) Factorial moments in terms of sums or differences; (2) fitting of polynomials by the method of least squares.—S. **Lees**: The effect of internal friction on stress-strain relationships for elastic solids.

Royal Astronomical Society, May 9.—Major Hills, C.M.G., F.R.S., president, in the chair.—Rev. A. L. **Cortie**: The mode of propagation of the sun's influence in magnetic storms. The author considered that the rays which proceed from the sun are not single kathode rays, as frequently assumed, but divergent. The solar corona as photographed at the eclipses of 1893, 1898, 1905, and 1908 showed systems of diverging rays apparently connected with spot groups. The study of these led to the conclusion that the mode of propagation of the influences which condition magnetic storms from the sun has the form of rays diverging from the foci of sun-spot disturbances. The sun-spots would not directly cause the storms, but rather condition them, perhaps by rendering the upper atmosphere a better electrical conductor.—H. **Kimura**: The harmonic analysis of sun-spot relative numbers.—H. H. **Turner**: The harmonic analysis of Wolf's sun-spot numbers, with special reference to Mr. Kimura's paper.—J. **Jackson**: The discordance between the observed and predicted positions of Jupiter's eighth satellite. The author made an appeal for further observations during the present year, which is a favourable occasion, as the satellite is now as much as 3° from the planet; the observations would have to be made in southern latitudes owing to the position of Jupiter. R. A. **Sampson**: The correction of the field of a Newtonian reflector. The various defects of spherical aberration, coma, astigmatism, curvature of field, and distortion were separately dealt with, and an arrangement of three lenses was suggested, which would render the field of a Newtonian reflector practically perfect.—C. V. L. **Charlier**: An investigation on the motion of the stars.—**Royal Observatory, Greenwich**: The photographic magnitudes determined with the Greenwich astrographic equatorial; corrections depending on distance from the plate-centre.

PARIS.

Academy of Sciences, April 28.—M. F. Guyon in the chair. A. **Haller** and Edouard **Bauer**: The methylation of *iso*valerone by means of sodium amide and methyl iodide. Tetramethyl*iso*valerone or 2:3:3:5:5:6-hexamethyl-4-heptanone. The di-, tri-, and tetramethyl*iso*valerones were isolated from the crude product of the reaction between sodium amide, *iso*-valerone, and methyl iodide. The tetra-derivative was reduced to the corresponding alcohol by means of sodium and ethyl alcohol.—A. **Laveran** and M. **Marullaz**: Contribution to the morphological study of *Toxoplasma gondii* and of *T. cuniculi*. From the morphological point of view the differences between *T. cuniculi* and *T. gondii* are not sufficiently marked to justify their distinction into two species.—M. **Gouy** was elected a non-resident member, M. **Schwoerer** a correspondant for the section of mechanics (in the place of the late M. Dwelshauvers-Dery), and Prof. W. M. **Davis** a correspondant for the section of geography and navigation (in the place of the late Sir George Darwin).—M. **Simonin**: Results of the discussion of the observations made during the eclipse of the sun of April 16–17, 1912. From a discussion of all the available observations it is concluded that the first external contact was observed on the average six seconds too late, and the last contact three seconds too soon; the observations of the interior contacts appear to be free from systematic error.—G. H. **Hardy** and J. E. **Littlewood**: The Fourier's series of a squared function capable of summation.—Louis **Roy**: The movement of viscous media and quasi-waves.—Albert **Turpain**: The application of highly sensitive galvanometers to geodesy. A description of a special type of galvanometer capable of registering the time signals of the Eiffel Tower.—J. M. **Laby**: The rectification of records deformed by the circular movements of the inscribing point.—Georges **Claude**: The absorption of neon by the electrodes of luminescent tubes. Neon is characterised by a remarkable resistance to absorption by the electrodes, as compared with helium or nitrogen. This fact is of practical importance in connection with the use of neon tubes for lighting purposes.—Ed. **Chauvenet** and G. **Urbain**: The density of the double salts. The case of the chlorides of copper and ammonium.—Jean **Bielecki** and Victor **Henri**: The quantitative study of the absorption of the ultra-violet rays by ketones, diketones, and the ketonic acids.—A. **Guyot** and A. **Kovache**: The action of formic acid upon the colouring matters derived from triphenylmethane.—Gustave **Chauveaud**: The evolution of the conducting apparatus in Veronica.—Raoul **Bayeux**: The comparative resistance of the dog and the rabbit to intravenous injections of oxygen. In proportion to its weight, the dog can tolerate in its veins a quantity of oxygen more than twenty-five times greater than a rabbit.—H. **Charrier**: Some modifications of the muscular tissue at the moment of sexual maturity in *Nereis fucata*.—Bernard **Collin**: A new Ellobiopsis, a parasite of *Parallobiopsis coutieri*. F. **Picard** and G. R. **Blanc**: A bacillary septicæmia in the caterpillars of *Arctia caja*.—R. **Marcille**: The use of ammoniacal salts in vinification. Musts deficient in volatile nitrogen and requiring an undue length of time for complete fermentation can be made to ferment normally by the addition of ammonium phosphate or sulphate.—H. **Dorlencourt**: Study on the urinary elimination of morphine injected into an animal not previously treated with the drug. A small proportion of morphine injected into the rabbit is always eliminated by the kidney. The morphine is recovered from the urine, unchanged, traces only of oxydimorphine being detected.—Ph. **Glangeaud**: The eight eruptive phases of the volcano of Puy de Côme.—M. **Aubert**: Beynes in prehistoric times.

May 5.—M. F. Guyon in the chair.—Armand **Gautier** and Paul **Clausmann**: Fluorine in the animal organism. The skin and its appendages. A method for the exact determination of minute amounts of fluorine was worked out by the authors and described about a year ago. This method is now being applied to the systematic examination of various parts of the body for the amount of fluorine. The results for the skin, hair, dental enamel, and nails are given in the present paper.—M. **Bazin** was elected a non-resident member.—Charles **Nordmann**: The effective temperatures of the stars. A comparison of the results obtained for twelve stars by Rosenberg and the author. Although the methods used were based on different principles, with one exception (α Lyra), the agreement in the estimated temperatures is close, the differences being of the order of the experimental error. The results agree with the thermal classification of Sir Norman Lockyer, deduced from the qualitative study of stellar spectra.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the first quarter of 1913. Observations were possible on sixty-five days, and tables are given showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Th. **Anghelutza**: Some remarks on the exponential development of Cauchy.—G. **Bouligand**: Green's function for an indefinite cylinder. M. **Hadamard**: Remarks on the preceding note.—J. de **Boissoudy**: The constant of the law of radiation. —G. A. **Dima**: The influence of the valency of the metal on the photoelectric effect of metallic compounds. In all the cases examined the compound in which the metal has the smallest valency appears to have the greatest photoelectric power.—Louis **Riéty**: The electromotive force produced by the flow of solutions of electrolytes through capillary tubes. Data are given for solutions of varying concentrations of potassium chloride, nitrate and sulphate, potash, hydrochloric and sulphuric acids.—C. **Gutton**: The determination of the time required for the establishment of electrical double refraction. The times found ranged from 0·6 to 1·4 hundred-millionth of a second. These are of the order of Maxwell's time of relaxation, and agree with the theory that double refraction is the result of a molecular orientation.—H. **Magunna**: A mechanical means for keeping tuning-forks or plates in continuous vibration.—Em. **Vigouroux**: The transformations of the alloys of iron and silicon. A discussion of a recent paper by G. Charpy and A. Cornu concerning the transformation point A_2.—G. **Reboul**: Chemical reactions and radii of curvature. It has been shown by the author that the chemical action of a gas on a solid depends on the form of the latter, the action being greatest at the points where the curvature of the solid is greatest. It is now found that if two copper wires of different diameter are placed close together in an atmosphere capable of forming a compound with the copper, the fine wire appears to exert a protective action on the coarser wire, the former only being attacked.—Camille **Matignon**: The preparation of barium. An intimate mixture of barium oxide and silicon in the proportion 3BaO : Si is heated in a steel tube to 1200° C.; barium is formed, and distils into the cooler portion of the tube. The yield is good, and the metal proved to be of 98·5 per cent. purity. Ferrosilicon with 95 per cent. silicon can replace the silicon.—M. **Hanriot** and A. **Kling**: The action of reducing agents on the chloraloses. Sodium and aluminium amalgams were used as reducing agents; compounds containing one and two atoms of chlorine were isolated and described.—A. **Wahl** and P. **Bagard**: Syntheses in the indigo group.—Marcel **Lantenois**: The preparation of carbon tetraiodids. Two methods were found practicable, the interaction of carbon tetrachloride and lithium iodide and the action of hypochlorite upon iodoform in strongly alkaline solutions. An advantageous method of purifying the crude product is given.—C. **Gaudefroy**: Dehydration figures.—Aug. **Chevalier**: The botanical origin of commercial Gabon woods.—J. **Beauverie**: The question of the propagation of rust in the Graminaceæ. The presence of mycelium, uredospores, or teleutospores of rusts in the interior of the seeds of cultivated Graminaceæ is very common, and it is necessary to take this fact into account in the study of the question of the propagation of rust.—E. **Perrot**: Observations on the preparation of cocoa. Improvements are suggested on the method of preparing the cocoa bean for the market in current use.—A. **Pinard** and A. **Magnan**: Researches on sexuality in births.—Henri **Béclère**: Pressure and thermometry in cryotherapy. An iron-constantan thermocouple has given good results, not only in determining the temperature in the freezing mixture (solid carbon dioxide), but also the temperature at the surface of application. Pierre **Girard**: The osmotic relations of the red corpuscles with their medium: rôle of the electric state of the wall.—Auguste **Lumière** and Jean **Chevrotier**: The action of oxidising agents in general and alkaline persulphates in particular on the tetanus toxin. Remarks on a recent note by Marcel Belin. Details are given of the success attained in the treatment of tetanus by injections of sodium persulphate. —Jacques **Surcouf**: The transmission of the larvæ of *Dermatobia cyaniventris* by a mosquito.—Albert **Robin**: The retention of chlorides in the liver and the blood of cancerous subjects.—E. **Voisenet**: Cream of tartar as a food for the ferment causing bitterness in wine. The *Bacillus amaracrylus* can utilise sugars and glycerol as food, but is inactive in presence of tartaric acid and its salts.—G. **Malfitano** and Mlle. A. **Moschkoff**: Pseudo-crystals of starch and crystals of glucose.—H. **Labré** and R. **Maguin**: Contribution to the study of the conditions of precipitation of albumen by picric acid. Working with a constant excess of picric acid, the relation between the amount of albumen present and the quantity of picric acid combined with it is not a linear one, but can be represented by an equilateral hyperbola. The phenomenon would appear to be one of adsorption, but it can be made the basis of a practical method for the estimation of albumen.—Jean **Chautard**: The origin of petroleum at Wyoming. —J. **Bosler**: Magnetic storms and hysteresis phenomena.

BOOKS RECEIVED.

Ma Leçon—Type d'entraînement complet et utilitaire. By Lieut. G. Hébert. Pp. 208. (Paris: Vuibert.) 1.75 francs.

La Secrétion Pancréatique. By E. F. Terroine. Pp. 133. (Paris: A Hermann et Fils.) 5 francs.

I Fenomeni Magnetici nelle Varie Teorie Elettromagnetiche. By Silvio Magrini. Pp. 165. (Bologna: N. Zanichelli.)

The British Empire with its World Setting. By J. B. Reynolds. Pp. viii+200. (London: A. and C. Black.) 1*s*. 4*d*.

English History Illustrated from Original Sources, 1715–1815. By H. E. M. Icely. Pp. xv+101+viii+107. (London: A. and C. Black.) 2*s*.

Elementary Algebra. By C. Godfrey and A. W. Siddons. Vol. ii. Pp. xi+227–530+xlvi. (Cambridge University Press.) With answers, 2*s*. 6*d*.; without answers, 2*s*.

Four-Figure Tables. By C. Godfrey and A. W. Siddons. Pp. 40. (Cambridge University Press.) 9*d*. net.

The Seashore I Know. Edited by W. P. Westell and H. E. Turner. Pp. 80. (London: J. M. Dent and Sons, Ltd.) 8*d*. net.

Continuous Beams in Reinforced Concrete. By B. Geen. Pp. iv+210. (London: Chapman and Hall, Ltd.) 9*s*. net.

Die deutschen Salzlagerstatten. By Dr. C. Riemann. Pp. 97. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Die neueren Warmekraftmaschinen. II., Gaserzeuger, Grossgasmaschinen, Dampf- und Gasturbinen. By Prof. R. Vater. Pp. vi+116. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Introductory Electricity and Magnetism. By C. W. Hansel. Pp. xv+373. (London: W. Heinemann.) 2*s*. 6*d*. net.

Sex Antagonism. By W. Heape. Pp. 217. (London: Constable and Co., Ltd.) 7*s*. 6*d*. net.

Dent's Practical Notebooks of Regional Geography. By Dr. H. Piggott and R. J. Finch. Part ii., Asia. Pp. 64. (London: J. M. Dent and Sons, Ltd.) 6*d*. net.

The Conception of a Kingdom of Ends in Augustine, Aquinas, and Leibniz. By E. H. Stokes. Pp. iv+129. (Chicago: University of Chicago Press; Cambridge University Press.) 3*s*. net.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief. 41 and 42. (Jena: G. Fischer.) 2.50 marks each Lief.

Canada. Department of Mines. Geological Survey. Memoir No. 17E. Geology and Economic Resources of the Larder Lake District, Ont., and Adjoining Portions of Pontiac County, Quebec. By M. E. Wilson. Pp. vii+62+xi plates. (Ottawa: Government Printing Bureau.)

Manual of Qualitative Analysis: Reagent and Combustion Methods. By W. F. Hoyt. Pp. vi+35. (London: Macmillan and Co., Ltd.) 1*s*. 3*d*. net.

The Oxford Geographies:—An Introduction to Plant Geography. By Dr. M. E. Hardy. Pp. 192. (Oxford: Clarendon Press.) 2*s*. 6*d*.

Mineral and Aerated Waters. By C. A. Mitchell. Pp. xiii+227. (London: Constable and Co., Ltd, 8*s*. 6*d*. net.

The Pathology of Growth. Tumours. By Dr. C. P. White. Pp. xii+235. (London: Constable and Co., Ltd.) 10*s*. 6*d*. net.

DIARY OF SOCIETIES.

FRIDAY, MAY 16.

ROYAL INSTITUTION, at 9.—The Pygmies of New Guinea: Captain C. G. Rawling.

PHYSICAL SOCIETY, at 8.—Some Experiments to Detect β rays from Radium A.: Dr. W. Makower and Dr. S. Russ.—Dust Figures: Dr. J. Robinson.

SATURDAY, MAY 17.

ROYAL INSTITUTION, at 3.—Humphrey Internal Combustion Pumps: H. A. Humphrey.

TUESDAY, MAY 20.

ROYAL INSTITUTION, at 3.—Recent Advances in the Production and Utilisation of Wheat in England: Prof. T. B. Wood.

ROYAL STATISTICAL SOCIETY, at 5.—The Census of Ireland, 1911: Sir W. J. Thompson.

ZOOLOGICAL SOCIETY, at 8.30.—Notice of Some Important Works on Zoological Nomenclature Now in Progress: Rev. T. R. R. Stebbing.—Observations on the South African Rhynchocephaloid Reptile Euparkeria and Allied Genera: Dr. R. Broom.—Experiments on the Metamorphosis of the Axolotl (*Amblystoma tigrinum*) conducted in the Society's Gardens: E. G. Boulenger.—Some Cases of Blindness in Marine Fishes: G. E. Bullen. The Patella in the Phalacrocoracidæ: Dr. R. W. Shufeldt.

WEDNESDAY, MAY 21.

ROYAL GEOGRAPHICAL SOCIETY, at 8.45.—Reception of Members of Captain Scott's Antarctic Expedition. Lecture by Commander E. R. G. R. Evans, R.N.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—Determination of the Radiation of the Air from Meteorological Observations: E. Gold.—Results of Monthly and Hourly Cloud-form Frequencies, at Epsom, 1903–1910: S. C. Russell.

AERONAUTICAL SOCIETY, at 8.30.—Wilbur Wright Lecture.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Annual Exhibition of Microscopic Aquatic Life.

THURSDAY, MAY 22.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: Rays of Positive Electricity: Sir J. J. Thomson.

ROYAL INSTITUTION, at 3.—Recent Chemical Advances. I. Molecular Architecture: Prof. W. J. Pope.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting.

CONCRETE INSTITUTE, at 4.30.—Annual General Meeting.

INSTITUTION OF MINING AND METALLURGY, at 8.

FRIDAY, MAY 23.

ROYAL INSTITUTION, at 9.—The Secret of the Permanent Magnet: Prof. S. P. Thompson.

SATURDAY, MAY 24.

ROYAL INSTITUTION, at 3.—Radio-activity. I. The α Rays and their Connection with the Transformations: Prof. E. Rutherford.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2273, Vol. 91] THURSDAY, MAY 22, 1913 [Price Sixpence

Registered as a Newspaper at the General Post Office.]

THURSDAY, MAY 22, 1913.

THE ROYAL SOCIETY'S SUBJECT INDEX.

Royal Society of London. Catalogue of Scientific Papers, 1800–1900. Subject-Index, Vol. iii., Physics. Part i., Generalities, Heat, Light, Sound. Pp. c + 550 + vii. (Cambridge University Press, 1912.) Price 18*s*. net.

THE most obviously essential qualities of a work of reference such as this are accuracy, comprehensiveness, and a lucid arrangement of the contents, so that anyone using the book may readily find the information he is in search of. The test of accuracy must lie in the result of long usage, but, in the present case, so far as an *a priori* guarantee can go, we have it in the auspices under which the book is produced. As to comprehensiveness, while absolute completeness is no doubt unattainable, most of those who have occasion to consult the work before us will be satisfied with the statement that it "contains 33,344 entries referring to the papers contained in 1261 serial publications." Even these numbers convey little idea of the comprehensive scale of the whole book of which the volume we are considering forms a part, unless it is borne in mind that it deals with only those parts of the science of physics which are included under the headings generalities, heat, light, sound, leaving the great subjects electricity and magnetism for another volume, and unless we remember, further, that the whole of physics constitutes only one of seventeen sciences included in the schedule of the International Catalogue. These sciences are mathematics, mechanics, physics, chemistry, astronomy, meteorology, mineralogy, geology, geography, palæontology, biology, botany, zoology, anatomy, anthropology, physiology, and bacteriology.

The volume relating to pure mathematics was published in 1908 and contains 38,748 entries referring to 700 serials, and the volume on mechanics, published in 1909, contains 21,295 entries referring to the papers contained in 959 serials. This makes a total of 93,387 entries contained in the three already-published volumes of the catalogue, or, if we assume that the second half of "Physics" will yield as many as the first half, we get an estimated total of more than 126,000 entries for the first three sciences in the above list. Of the remainder, some will no doubt provide a smaller number than the average of those already dealt with, but others will probably furnish quite as many. This may suffice to give some idea of the comprehensive character and immense scale of the work which the Royal Society's committee has undertaken in the compilation of this catalogue.

The arrangement of the matter has obviously required very careful consideration. A purely alphabetical arrangement of such an immense number of entries relating to such a great variety of subjects would clearly have resulted in a series of bewildering lists wherein the search for a particular item would have been like that for a needle in hay. The arrangement actually adopted is founded on an elaborate attempt at a rational classification of the subject-matter of the sciences dealt with. This is carried out by a series of successive divisions and subdivisions, the nature of which can be best shown by an example. Thus the general subject of Heat is first distributed among the following main divisions: General; Sources of Heat and Cold; Thermometry; Relations involving Expansion and Stress; Calorimetry and Specific Heat; Phenomena of Change of State; Thermal Conduction and Convection; Thermo-dynamics. Each of these main divisions is subdivided into numbered headings; thus, to take a comparatively compact example, Calorimetry and Specific Heat comprises the following headings: 1600, General, Units of Heat; 1610, Calorimetric Methods; 1620, Specific Heats of Solids and Liquids; 1640, Specific Heats of Gases and Vapours; 1660, Chemical Constitution and Specific Heat; 1670, Heats of Fusion; 1680, Heats of Vaporisation; 1690, Heats of Dissolution; 1695, Heats of Transformation.

The numbers greatly facilitate cross-reference. It will be seen that they do not run continuously and that the intervals between them are not uniform. These intervals make it possible to expand the index in future by inserting additional entries without disturbing those to which numbers have already been assigned. For some rather occult reason the reference numbers all have four figures, the first half-dozen being 0000, 0010, 0020, 0030, 0032, 0040. These numbered headings are in most cases again subdivided, sometimes to a considerable extent, before we come to the references to individual papers.

The extreme terms of this series of divisions and subdivisions, namely, a branch of science and a particular paper relating to some matter falling under this branch, are determined by the nature of the case; but there is room for almost any amount of difference of opinion as to how many intermediate terms should be interposed, and where they should be placed. The ultimate criterion in this matter should be, in our opinion, the degree of ease and convenience with which a student wishing to follow up a particular subject can find references to what has been already published in relation to it. To facilitate this kind of reference is, in fact, the whole purpose of the book. Some degree of arrangement and classification of contents is needful to make the index usable at all, and this begins when one science is marked off from another; but the more minutely the classification is carried out, and the smaller the resulting classes become, the more chance there is of uncertainty as to the class in which a particular paper should be placed. If the question is answered in one way by the compilers of the index and in another way by a person who wishes to use it, the natural consequence is that he does not find the information he wants in the place he turns to first. The fact is that any possible classification is in a great degree arbitrary and conventional. The grouping of scientific results that at any time seems most natural and logical inevitably reflects not only the then existing state of knowledge, but also the successive stages by which that state of knowledge has been reached. New additions to scientific knowledge are not like bricks added to a building each of which occupies a fixed position and a sharply defined space; each newly recognised fact sheds light on what was known before and may greatly alter the apparent relative importance of previous acquisitions.

That such considerations are not irrelevant to the arrangement of this index is shown by the entry of thirteen references to papers on heat developed on moistening solids, under the general heading **0300 Capillarity,** and also under **Phenomena of Change of State, 1800 General.** There are, in fact, hosts of phenomena which are essentially related to more than one division of science, and papers dealing with them must necessarily be entered under more than one heading unless the index is to be encumbered by a tangle of cross-references.

We are fully conscious that the Royal Society's committee and the compilers of the index, who have considered the matter as a whole, may have good reasons for deciding on subdivisions and schemes of arrangement the advantages of which are not at once evident to anyone who has only partially examined a part of their work. It is therefore with the greatest diffidence that we venture to raise the question whether the classification on which the arrangement of the index is founded is not in some cases too minute. Thus the first entry under the heading **2410, Mechanical Equivalent of Heat,** gives a reference to Joule's classical paper in the Philosophical Transactions for 1850, and lower down, under the same general heading, we find references to Rowland's determination and to Reynolds and Moorby's; but Joule's final measurement (Phil. Trans., 1879) is given under a separate sub-heading, **Determination of Mechanical Equivalent,** under which we also find Griffiths (Phil. Trans., 1894), Miculescu (1892), and many others, and, under a sub-sub-heading, "Electrical Method," Joule's determination of 1867. We do not doubt that there are intelligible reasons for the separations and collocations of which these are examples, but we confess that to us personally they are more bewildering than helpful. For a long time we were not able to find any reference to Schuster and Gannon's measurement by the "electrical method," but at last we discovered it, as well as Rowland's and various other determinations, under "Specific Heat of Water." This is quite an appropriate place, but it is not easy to see why this paper should not also have been entered among determinations of the mechanical equivalent.

It is no doubt in consequence of our not having mastered the classification adopted by the committee that we have not been able to find references to such historically important investigations as those of Dulong and Petit into the expansion of mercury, the laws of cooling, and the specific heats of metals. The real difficulty of finding a thoroughly satisfactory system of arrangement arises partly from the enormous mass of material to be dealt with, but still more from the extreme complexity of the material. A strictly alphabetical arrangement offers an alluring simplicity, but a very slight examination of the contents of this volume must convince anyone that it would be hopeless to apply it until the matter has undergone a preliminary process of arrangement and sifting. The only questions that can arise are as to how this process shall be conducted, and how far it shall be carried; and probably scarcely any two men would answer these questions in exactly the same way.

There is no question that the index is a very remarkable and admirable piece of work, on which the Royal Society's committee, the director, Dr. McLeod, and all his colleagues deserve to be heartily congratulated. It will not only be of immense service to those engaged in the study of special questions, but it will help to keep alive a knowledge of the work of the men who laid the foundations of physical science. This work, like foundations generally, is apt to be buried out of sight as the superstructure rises, but it is well that modern builders should cherish the memory of those who made their work possible.

We find it difficult to close this volume without comparing it with Dr. Thomas Young's "Catalogue of Works relating to Natural Philosophy and the Mechanical Arts," published a little more than a century ago (1807), which, for its time, and as the work of one man, was as wonderful as the present index. The comparison affords a more trustworthy indication of the advance of natural knowledge during the nineteenth century than could probably be obtained in any other way.

G. C. F.

A NEW TEXT-BOOK OF MINERALOGY.

Mineralogy: an Introduction to the Theoretical and Practical Study of Minerals. By Prof. A. H. Phillips. Pp. viii+699. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1912.) Price 16*s*. net.

PROF. PHILLIPS'S text-book on mineralogy follows, on the whole, the usual lines of such works, and in price and size comes intermediately between Miers's well-known treatise, which appeared eleven years ago, and Dana's small book, a new edition of which, prepared by Ford, was published recently. By his experience in teaching the subject the author is well qualified to write a book suitable for students who wish to acquire a sound working knowledge of mineralogy.

As will be evident from the titles of the three parts into which it is divided, viz., crystallography, descriptive mineralogy, and determinative mineralogy, the book is comprehensive in its scope. Since each forms a subject wide enough to fill a book in itself, the author of a work dealing with all three is confronted with the difficulty of deciding how to keep the size within reasonable dimensions. On the whole, Prof. Phillips has succeeded in well covering all the ground necessary for the average student of mineralogy. We must acknowledge a debt of gratitude to him for resisting the temptation—irresistible to most writers on crystallography—of devising a brand new set of names for the thirty-two classes of crystal symmetry; he has wisely followed Miers, because the latter's nomenclature embodies the type of symmetry, and is therefore more easily remembered. Some surprise may be felt that little trace of Penfield's teaching should be evident in the discussion of the method of drawing crystals; the old one, in which an axial-cross is used, alone is considered, and no mention is made of the simple and convenient methods based upon the stereographic or gnomonic projections.

The whole subject of the goniometrical measurement of crystals is treated in a very elementary manner, and is confined to the instrument with a single circle; the theodolite goniometer, with two circles, which is used by many crystallographers in the United States, especially those who have studied under Goldschmidt, is not referred to, and it would seem that few students at Princeton University prosecute their studies very deeply into crystallography. The optical characters of crystals, on the other hand, are more fully dealt with, the reason no doubt being that an adequate knowledge is essential to the practical petrologist in the determination of the constituent minerals of a rock from a microscopic study of a thin-section.

The first part includes an interesting chapter on the relations of individual crystals, in which attention is directed to the parallel growths of one mineral on another, the full importance of which subject has largely been brought out by Barker's researches during recent years.

The second part includes three chapters which we should have imagined more in place in the first part, viz., the relation of the minerals to the elements, which covers such matters as topic parameters and the classification of minerals, the origin of minerals, and, lastly, the physical properties—for instance, cleavage and fracture, hardness, specific gravity, structure, colour, phosphorescence, &c. The part proper is devoted to concise descriptions of the characters and localities of the principal mineral species. At the head we have an abstract of their properties—chemical composition, crystalline system and type of symmetry, common forms, hardness, specific gravity, streak, colour, lustre, transparency, refractive indices—and then follows a general description of the crystals from the principal localities; in certain instances a few words are said about the use of the mineral or the metal derived from it.

Part iii. is given up to the methods of blowpipe analysis, the apparatus used, and the tables necessary for the identification of the various minerals, and is founded on Brush's well-known book. The tables provided include also one for the determination of minerals from their physical characters, dependence being placed mainly upon the hardness, streak of the softer and colour of the harder minerals, specific gravity, and cleavage, and another for the determination of the principal rock-forming minerals from their optical characters as given in a thin-section. The book ends with a full index, the use of which is facilitated by the employment of a different type for the numbers of the pages in each part of the book.

So far as we have tested it, the book seems satisfactorily accurate. Two curious mistakes have, however, crept into the description of the Cullinan diamond, the date of the discovery being wrongly stated to be June 6, instead of January 25, 1905, and the weight given being too high.

HEREDITY AND RELATED STUDIES.

(1) *Vererbungslehre. Mit besonderer Berücksichtigung des Menschen, für Studierende, Aerzte und Zuchter.* By Dr. Ludwig Plate. Pp. xii + 519 + 3 plates. (Leipzig: W. Engelmann, 1913.) Price 18 marks.

(2) *Genetics: An Introduction to the Study of Heredity.* By Prof. H. E. Walter. Pp. xiv + 272. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 6*s.* 6*d.* net.

(3) *The Fitness of the Environment: An Inquiry into the Biological Significance of the Properties of Matter.* By Prof. L. J. Henderson. Pp. xv + 317. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 6*s.* 6*d.* net.

(4) *Moderne Probleme der Biologie.* Prof. C. S. Minot. Pp. vii + 111. (Jena: Gustav Fischer, 1913.) Price 3 marks.

(5) *Vorträge über Deszendenztheorie.* By August Weismann. Dritte umgearbeitete Auflage. Erster Band and Zweiter Band. Pp. xiv + 342 + vii + 354 + 3 plates. (Jena: Gustav Fischer, 1913.) Price 13 marks.

(1) PROF PLATE'S excellent book gives a clear and comprehensive account of the present state of the study of heredity. The author is already known as an experimental investigator on the genetics of coat colour in mice, and as a student of heredity in man. Moreover, as the volume shows, he has a wide knowledge of the literature. The chief feature of the book, in which it differs most from works of a kindred nature, is the amount of space allotted to human heredity. Nearly one-fifth of the book is devoted to this subject, and most cases of which anything is known in man come in for review. It is certainly the best general account of this side yet written, and for this reason, if for no other, should be of special value to students of eugenics and to medical men. We notice that the author still adheres to the ingenious theory which he put forward some two years ago to account for the peculiar phenomena of inheritance in cases such as colour-blindness and hæmophilia, where the unaffected females transmit the affection to their sons. The theory is largely based upon the unusual proportions of the sexes in certain matings among such families. Lenz, however, has recently suggested that these proportions are due to the way in which the material is necessarily selected, and that Plate's explanation is probably incorrect. The volume is attractively and clearly written, and is well illustrated with more than 170 figures and three coloured plates.

(2) Prof. Walter states explicitly in his introduction that he is not engaged in research in the subject of which he treats. The book professes to be but a summary which may be useful in college courses, and of interest to the general reader, nor does the author aim at more than "out of the jargon of many tongues to raise a single voice which shall attempt to tell the tale of heredity." As a tale to be told the book cannot be judged a success. It gives one the impression of lecture notes carefully taken and displayed under appropriate labels. There is a little about much, and on the whole the information given is sound second-hand. The only attempt at originality is to be found in some of the diagrams. It is always refreshing to get away from the hackneyed stock, but we cannot help feeling that in some cases the author has got a little too far away. Fig. 2 is intended to illustrate the continuity of protoplasm, but it inevitably challenges comparison with a Cubist picture. Fig. 31, "a diagram to illustrate various ideas about species," calls to mind what is occasionally to be seen in an elementary student's notebook naïvely labelled "Amœba," while fig. 45 looks like the plan of a theatre auditorium somehow disarticulated. But perhaps it is ungrateful to criticise originality, and the book will doubtless be found of use by the student who wishes to "get up" the subject for examination in the shortest time.

(3) The genesis of this volume is explained in the opening sentences of the preface.

"Darwinian fitness is compounded of a mutual relationship between the organism and the environment. Of this, fitness of the environment is quite as essential a component as the fitness which arises in the process of organic evolution; and in fundamental characteristics the actual environment is the fittest possible abode of life. Such is the thesis which the present volume seeks to establish."

Rather on the lines of the old Bridgewater treatises, which he has evidently studied, the author proceeds to argue that the more recent discoveries in the realms of physics and chemistry all confirm the idea that from the inorganic side this is the fittest of all possible worlds to form an environment for living matter. Water in respect to all its many properties is the fittest of fluids to exist in the quantities that it does, and in the author's opinion it would be to introduce a serious element of unfitness were it replaced, for example, by liquid ammonia. Carbon dioxide also shows itself

"in its physico-chemical traits variously fitted for the organic mechanism. Less various, to be sure, and less obvious than those of water, such fitnesses as it does possess are quite as genuine."

Of the three elements carbon, hydrogen, and oxygen, the author concludes that:

"Each by itself, and all taken together, possess unique and preëminent fitness for the organic mechanism."

Nor is the ocean forgotten, but comes in for a whole chapter and a warm encomium. The latter part of the book is devoted to a discussion on vitalism and teleology, and the author uses the "fitness" of things physical as an argument for a mechanistic interpretation of things organic. For the "fitness" of the physical world appears to imply teleology. Nevertheless, mechanism is enough. Hence the semblance of teleology is misleading, and therefore mechanism must suffice for biology also. Perhaps Dr. Henderson's position with regard to vitalism may best be illustrated by the remark of Laplace, which he himself quotes. When the philosopher was asked by Napoleon why the name of God did not occur in his *Mécanique céleste* he replied: "Sire, je n'ai pas besoin de cet hypothèse."

(4) Prof. Minot's book is the outcome of six lectures delivered by him at Jena in the capacity of "Exchange-Professor." After a preliminary lecture on the nature of cells he develops his views on the changes that occur in the life cycle from fertilisation until death. With fertilisation comes the inception of a process of rejuvenescence characterised by the formation of a number of undifferentiated cells, and with a great proportional increase in the total amount of nuclear material in the organism. Then comes a stage where the tissues develop, where they undergo a process of differentiation or cytomorphosis, as the author terms it. This is eventually followed by degeneration and ultimately by death. Death is the price paid for differentiation. Such is the tale. We rot and rot, but Prof. Minot sees the rotting starting earlier than the poet does. Senescence is the outcome of cytomorphosis, and as this is most active in comparatively early embryonic stages it follows that we are rotting most rapidly before we are born. After that we are let down more gently. The book rambles a good deal, and a chapter is devoted to the determination of sex, though it seems scarcely germane to the main thesis. Possibly it owes its place to its being an attractive subject for a course of semi-popular lectures.

(5) The last edition of this well-known work appeared in 1904, and was reviewed in NATURE for June 29, 1905. The greater part of the present edition is a reprint of the earlier one, but in one respect there is a change. Lectures 22–24, dealing with heredity, have been rewritten, and a fresh lecture added. The change was necessitated by the great progress made in these studies during the past few years owing to the discovery of Mendel's work. Weismann's second edition appeared four years after that discovery, and the matter was then dismissed in a few lines. To-day the position is accepted, and the author endeavours to bring the new facts into line with his theory. That the conception of segregation fits in a general way with his views on the nature of chromosomes is obvious. But, as he himself recognises, difficulties begin to appear as soon as the matter is more carefully considered.

One of the difficulties at the root of the chromosomal interpretation of hereditary factors is the fact that in some species already, *e.g.* Triticum, Lathyrus, and Antirrhinum, the number of factors identified is greater than the total number of chromosomes. Some investigators, notably Morgan, have sought to reconcile such cases with the chromosome hypothesis by means of Jansen's theory of "chiasmatypie," while others are inclined to question the sufficiency of the chromosome theory to explain segregation. Fresh facts, however, must decide the matter, and it is likely that the next few years will be critical years for Weismann's views. The present volume is of historical interest in showing the attitude of a great speculative mind when brought to face a new and unfamiliar body of facts, and it is much to be regretted that in shaping their interpretation a brain of such synthetic capacity is little likely to be available.

VON RICHTHOFEN'S "CHINA."

China: Ergebnisse eigener Reisen und darauf gegründeter Studien. Von Ferdinand Freiherr v. Richthofen. Dritter Band. Das südliche China. Herausgegeben von Ernst Tiessen. Pp. xxxi + 817 + 5 plates. Fünfter Band. Enthaltend die abschliessende palaeontologische Bearbeitung der Sammlungen F. von Richthofens, die Untersuchung weiterer Fossiler Reste aus den von ihm bereisten Provinzen sowie den Entwurf einer erdgeschichtlichen Uebersicht China's. By Dr. Fritz Frech. Pp. xii + 289 + 31 plates.

Atlas von China. Orographische und geologische Karten von Ferdinand Freiherr von Richthofen, zu des Verfassers Werk "China: Ergebnisse eigener Reisen und darauf gegründeter Studien." Zweite Abtheilung. Das südliche China (zum dritten Textband gehörig). Bearbeitet von Dr. M. Groll. Pp. 12 + plates 27–54. (Berlin: Dietrich Reimer, 1911–12.) Price, Bands III. and V., 32 marks; Atlas, 52 marks.

THESE volumes complete what may well be called the monumental work of Baron v. Richthofen on China, for the word is equally appropriate whether we regard the extent and importance of his researches, which will stand for all time as the foundation of our knowledge of the geology of the Chinese Empire, or whether we regard the fact that the author himself was only able to publish a portion of his work, the greater part having been prepared for and put through the press by the devoted industry of his friends and former pupils.

Of the two volumes before us, one contains v. Richthofen's account of his travels through southern China, edited and amplified by references to the observations of later travellers by E. Tiessen. These additions are most extensive in the account of the salt and gas fields of the upper Yangtsekiang, which v. Richthofen was prevented from visiting, where the ingenuity and indomitable perseverance of the Chinese have enabled them, in spite of the primitive nature of their appliances, to rival the achievements of the modern driller and to obtain a supply of natural gas from depths of 2000 ft. and even 3000 ft. The detailed observations of so acute an observer must always be of interest, and although all the more important results of his journey have already been published in one form or another, we welcome the completion of publication of the record, which will always be of importance and value to the student of the geology and physical geography of Eastern Asia.

The other volume is entirely the work of Dr. Fritz Frech, to whom Baron v. Richthofen entrusted the elaboration of the palæontological material collected by him. The description of the fossils is supplemented by a series of essays on the distribution and development of the different rock systems in China and Eastern Asia, and by a general review of the geographical evolution and the geological history of sea and land in China.

OUR BOOKSHELF.

Die gnomonische Projektion in ihrer Anwendung auf kristallographische Aufgaben. By Dr. H. E. Boeke. Pp. iv + 54. (Berlin: Gebrüder Borntraeger, 1913.) Price 3.50 marks.

This little book on the gnomonic projection of crystals is a welcome addition to crystallographic literature. The standard work on the subject, "Ueber Projektion und graphische Kristallberechnung," by Prof. V. Goldschmidt, of Heidelberg, was published in the year 1887, before the advent of the two-circle goniometer, which has both simplified the method and enlarged the field of usefulness of the gnomonic projection. The greater number of the subsequent improvements in the method we owe to Dr. G. F. Herbert Smith, Mr. H. Hilton, Dr. A. Hutchinson, Dr. J. W. Evans, Sir Henry Miers, Prof. von Fedorow, and Prof. F. E. Wright.

The gnomonic differs from the stereographic projection in that the plane of projection is a tangent plane to the sphere (within which the crystal is supposed to be concentrically situated), and the eye is imagined to be placed at the common centre of the sphere and crystal; while in the stereographic projection the eye is situated at the north or south pole of the sphere, and the plane of projection is that containing the equatorial great circle. Just as we have the most useful stereographic nets of Hutchinson, Penfield, and von Fedorow, so we have the gnomonic net of Hilton, and Herbert Smith has furnished us with a table to facilitate the plotting of the gnomonic diagram from the results of the measurements of the crystal made on the two-circle goniometer, an excellent type of which he has invented. With the exception that no mention appears to be made of the important work of Herbert Smith (no index is provided), Prof. Boeke has given in the concise space of fifty-four pages a very fair account of the principles of the method, together with some useful tables of chords and tangents. The illustrations are simple ones from original drawings of the author, and are very practical, but an obvious omission is that of a few typical gnomonic projections of fairly complex crystals belonging to each system of symmetry. Such a series of concrete examples would have afforded students a more comprehensive idea of the scope, possibilities, and actual application of the gnomonic projection.

A. E. H. T.

The Extra Pharmacopoeia of Martindale and Westcott. Revised by Dr. W. Harrison Martindale and Dr. W. Wynn Westcott. Fifteenth edition. Vol. i., pp. xxxi + 1114. Price 14*s*. net. Vol. ii., pp. viii + 370. Price 7*s*. net. (London: H. K. Lewis, 1912.)

This valuable work has now reached its fifteenth edition, eloquent testimony of its worth. The subject-matter has grown to so great an extent that it has been necessary to divide it into two volumes: the first, of more than 1000 pages, contains the description of the chemicals and drugs and the sections on vaccine and serum therapy, therapeutic index, &c.; the second embodies analytical and experimental work and a *résumé* of investigations on infective and other diseases. For the medical man and pharmacist, the book contains a wealth of information scarcely to be found in any other work, while numerous data are scattered through it which render it a volume of reference which will be found of the greatest service in the chemical and the biological laboratory.

R. T. H.

Practical Physiological Chemistry. By S. W. Cole. Third edition. Pp. xii + 230. (Cambridge: W. Heffer and Sons, Ltd., 1913.) Price 7*s*. 6*d*. net.

Under the title "Practical Exercises in Physiological Chemistry," this book was reviewed in the issue of Nature for March 2, 1905 (vol. lxxi., p. 412). In the present edition Mr. Cole directs particular attention to analytical methods. He urges that medical students should be taught the micro-chemical methods of urinary analysis introduced by Folin, and that more conclusive qualitative methods should replace Fehling's sugar-test.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Reflection of X-Rays and Related Phenomena.

In a letter to Nature of April 17, M. de Broglie described bands or fringes observed in the photographs produced by reflection of X-rays on certain crystals. Further experiments seem to show that there are two or even three different types of bands present, which must be attributed to different causes.

First, there is the ordinary dispersion, with the difference that in the case of a three-dimensional grating the spectrum of the primary beam, presumably continuous within certain limits, will appear as a series of bands as certain wave-lengths are destroyed by interference. This would lead to an apparently abnormal lengthening of the spots at a distance from the centre, which has, in fact, been observed. It would not, however, account for bands in the principal regularly reflected spot.

Secondly, the bands of interference described by Hupka and Steinhaus must be present whenever the primary beam is divergent. As was to be expected, these appear to be present in all the spots if the focus of the kathode rays on the anti-kathode is sufficiently small. They seem to indicate the existence of X-rays of considerably shorter wave-length than the average wave-length in the primary beam, and may possibly be due to fluorescent radiation.

Thirdly, very strongly marked bands are often observed, which must probably be attributed to invisible cracks along the planes of cleavage in the crystal. In certain circumstances the movement of the focus of the kathode rays in consequence of changes of hardness in the tube may enhance this effect. The fact that the bands are nearly equidistant in a large number of different crystals of the same substance might possibly be attributed to the varying velocity of growth of the crystal on account of the seasonal changes during its formation.

As M. de Broglie pointed out, analogous figures to those obtained by photographing the reflection of X-rays on cubic crystals may be produced by reflection of visible light on a square crossed grating. Laue's theory, which seems to be equivalent to Bragg's, if one assumes cubical packing, shows that only a limited number of lines of definite wave-lengths appear on the plate if one has a three-dimensional grating or space-lattice. Reflection on some crystals, *e.g.* the base of a prism of phosgenite, $(PbCl)_2CO_3$, appears to show all the spots a two-dimensional grating would lead one to expect, *i.e.* only the surface layer appears to come into play. Whether this is due to its opacity to X-rays or to the fact that the mean distance apart of the atoms in the direction vertical to the reflecting plane may be an irrational fraction of the distance in the reflecting plane, has yet to be investigated. If, however, one accepts the hypothesis that we have here reflection on the surface layer only—an hypothesis which the number and position of the spots would seem to justify—then we have in this case true spectra of the X-rays emitted by the tube and not, as in Laue's experiments, X-rays of definite wave-lengths sorted out by the grating. The spectra appear to comprise about one octave with a mean wave-length of $\lambda=0{\cdot}037c$, where c is the distance of two neighbouring reflecting atoms. It appears difficult to obtain good photographs with this crystal, as with most others containing elements of high atomic weight. This may be due to the increased amount of secondary fluorescent radiation and to the greater sensitiveness of the photographic plate to these rays.

The examination of a series of crystals of the regular system confirmed the consequence of all theories and the experiments of various physicists, that the figures obtained must depend only on the position of the plate and the crystal with respect to the primary beam. It is difficult to give definite data as to the reflecting power of different crystals, though it seems that it may be taken as a general rule that those composed of elements of lower atomic weight reflect better than those containing heavier atoms. The relative intensity of different spots varies in different crystals, probably according to the distribution of energy amongst the different wave-lengths in the primary beam. But even in one and the same crystal the intensity of different spots varies according to its position. Thus with an ordinary square crossed grating the spectra are at the points of intersection of a series of concentric circles and hyperbolæ. By turning the grating in its own plane by 45° the circles open out into hyperbolæ and *vice-versâ*. When the plane of incidence is parallel to the lines in the grating spots of equal brilliance are on the circles; at 45° the same spots, still of equal brightness, are on the hyperbolæ. The same experiment carried out with X-rays reflected on rock-salt shows that the spots of approximately equal brightness are on the circles.

M. de Broglie.
F. A. Lindemann.

Stratigraphical Problems in New Zealand.

Though I do not in any way object to the review of my book on the geology of New Zealand published in Nature (January 30, p. 591), I should like to explain further one or two points, for, from the manner in which they are quoted in the review, they are obviously open to misapprehension.

It is stated that "it is hard to comprehend why unconformity should be demanded as a proof of the distinction between two successive geological systems." The fact is that those who have wished to split the system of our younger rocks into distinct parts have insisted upon the existence of unconformities. Careful work has, I think, now shown conclusively that such breaks do not occur in these rocks. It is therefore the wish of some of us to represent these rocks as in fact they are: a simple conformable sequence. The lithological nature of all the lower members shows that they were deposited during a uniform and continuous movement of depression.

It is true that the lowest members of this sequence contain Cretaceous fossils. These Cretaceous sediments are followed by a considerable thickness (500 to 2000 ft. in different sections) of unfossiliferous rocks. Cainozoic fossils then begin to appear—in small numbers at first—but soon a luxuriant Miocene molluscan fauna is developed. It is, however, well to bear in mind, as is frequently mentioned by Hutton, that several of the genera appear in the Eocene sediments of Australia. Associated with the "Miocene" mollusca is an echinoid fauna consisting of thirty-two members, which, in a critical article by Tate, is said to be Eocene with a Cretaceous complexion; at any rate, all the members of it are extinct.

The point on which I wish to insist is this. All the lower members of this conformable sequence were deposited during the continuance of uniform physical conditions and in direct continuous succession. Some time after the Cainozoic fauna had appeared elevation commenced. A series of rocks deposited under such conditions should surely constitute a geological system in the country in which it occurs, even though it cannot be properly packed into European compartments.

My statement that "too much attention has been paid in the past to the palæontological evidence" is, when removed from its surroundings, obviously absurd. The point I wished to emphasise is merely that correlation based upon homotaxis can be pushed too far, and that it is unscientific to break up a uniform series of rocks that occurs in New Zealand into sharply separated divisions on the basis of the occurrence of fossils that in Europe are found at different horizons. It is in this sense only that I suggest that too much emphasis has been laid on the palæontological evidence in the past in New Zealand, especially as all the collections of fossils are still far from complete. I may add that for twenty years, owing to the influence of my old and revered teacher, the late Capt. Hutton, F.R.S., I endeavoured to apply his divisions of the younger rocks of New Zealand to the districts where I was at work. As difficulties finally became insuperable, I visited his typical localities in the expectation of getting information that would solve them. It was to my intense disappointment that I was forced to the conclusion that his divisions of the "system" were based upon what I considered to be incorrect observation of the field evidence.

P. MARSHALL.

Otago University, Dunedin, New Zealand.

PROF. MARSHALL's clear statement of the palæontological difficulties in this case should stimulate the search for further fossiliferous horizons. The Ordovician and Gotlandian beds of the British Isles were laid down in many places "during the continuance of uniform physical conditions and in direct continuous succession"; none the less, two systems have been conveniently maintained. The unwieldy "Karroo system" of South Africa would no doubt be split up were marine representatives of its strata available close at hand.

G. A. J. C.

Dana's Proof of Darwin's Theory of Coral Reefs.

I THINK Mr. Crossland, in his letter to NATURE of April 3, is mistaken in assigning a fault origin to the narrow "khors" which form the harbours along the Rea Sea coast. I visited a number of these during a land journey from Halaib to Port Sudan in 1908, and although I had not much time for detailed investigation, I saw nothing which pointed to any other origin than erosion and subsidence. The steep-sided character of the shallow valleys, which Mr. Crossland takes as indicative of a fault origin, is, I think, merely a consequence of the toughness of the coral-rock and the smallness of the rainfall in these regions. It is a character common to many inland "wadis" where there is no suspicion of rift action.

The occurrence of coral-reef coverings on the coast-hills is, of course, a proof of elevation of the land; but on what does Mr. Crossland base his conclusion that the elevation has been *continuous*? Has any systematic slickensiding or brecciation of the rocks, such as usually accompanies a fault, been observed along the sides of the valleys? Or has it been proved that the floors of the valleys consist of the same beds as occur at higher levels on either side?

Like Mr. Crossland, I write from the wilderness, and cannot now refer to the papers which he cites. But as an admirer of the devotion and skill with which Mr. Crossland has pursued his important biological researches on that desolate shore, I read his two last papers very carefully at the time of their publication. If my memory is correct, the papers contain no real evidence as to a fault-origin for the "khors." Rather does Mr. Crossland seem to take faulting for granted, and then to adopt it as the explanation for all the topographical features of the coast, even going so far as to regard Ras Raweiya as a piece torn from the mainland and shifted several miles out to sea—a view in which I imagine few geologists will agree.

Unless further facts can be adduced, I think the "khors" of the Red Sea coast are most reasonably explained as valleys which were eroded by streams when the land was at a greater elevation than it is now, and have since been submerged by subsidence.

JOHN BALL.

Wadi Baba, Sinai, April 20.

Sub-Red Crag Flint Implements and the Ipswich Skeleton.

I NOTICE that NATURE of May 8 contains an account of a paper read by Mr. W. H. Sutcliffe before the Manchester Literary and Philosophical Society, in which he refers to the sub-Red Crag flint implements and the pre-Chalky Boulder Clay human skeleton I have discovered.

Mr. Sutcliffe argues that because the rostro-carinate flints are found below the Red Crag, and (as he asserts) in the Palæolithic gravel of Hackney Downs, they cannot be of human origin, because it is "inconceivable that a human production should have retained exactly the same form throughout this immense period."

Apart from the fact that the rostro-carinate specimens have *not* retained exactly the same form during the periods in which they were used, it appears to have escaped Mr. Sutcliffe's notice that a river-gravel is composed of material of the most varied ages, and that therefore the examples of this type found in the Hackney Downs deposit need not necessarily be of Palæolithic age.

But even if they do belong to this period that has no bearing upon their "humanity"—the ordinary round-ended scraper was made in the most remote times, and is still used by the present-day Eskimo. Mr. Sutcliffe has also apparently "found" that the rostro-carinate flints are "not adapted to any likely use," and cannot therefore be held to afford good evidence of Pliocene man.

This is a very shaky and unsound objection, as it is open to anyone to "find" that the ordinary Palæolithic implement is practically useless, and therefore non-human.

Mr. Sutcliffe has evidently not carefully read the published accounts of the evidence in favour of the high antiquity of the Ipswich man. It has never been suggested that the skeleton was lying *on* a land surface of loose sand, and exposed to the direct action of moving ice, but that the bones had probably either been buried in that surface or covered by blown sand to a considerable depth.

If Mr. Sutcliffe had examined the evidence I have mentioned with an open and unbiassed mind, he would have recognised that the actual provenance of the Ipswich bones is as well established as any prehistoric skeleton yet unearthed.

J. REID MOIR.

Openings Required for Laboratory Assistants.

YOU have in the past been kind enough to insert a letter of mine with regard to the London County Council laboratory monitors, whose services the council is unable to retain after the age of seventeen, and whom it has requested this association to place in work. Thanks to the publicity which was given by NATURE to the needs of these young men, I was able to place a certain number of them in good commercial laboratories, and it is satisfactory to know that in nearly all cases they have justified my opinion of them and are doing well. More than thirty have been placed during the past three years, and are under my supervision still.

The council has recently referred to me a large number of these lads who are shortly leaving its service, and I should be glad to be permitted to make this fact known among readers of NATURE, as I am confident that should any employers desire promising assistants for their laboratories they would be able to obtain satisfactory applicants through this source. Applications should be made to the hon. secretary, Apprenticeship and Skilled Employment Association, 61 Denison House, 296 Vauxhall Bridge Road, S.W.

G. E. REISS,
Hon. Secretary.

May 14.

The Use of Spectacles with Optical Instruments.

WITH reference to the inquiry in NATURE of May 1 (p. 215), the general rule in cases where a person using spectacles wishes to use an optical instrument is, that for telescopes and instruments used for distant objects, use the distance correction; for microscopes and instruments for near work, the near correction should be worn. Care should always be taken to use the centre of the spectacle lens. If no astigmatism is present there is generally sufficient focussing room to enable the observer to dispense with the spectacles. The most comfortable method is to have a cap made for the eyepiece of the instrument with a lens equivalent to that in the spectacle. This should be set as close to the eye-lens as possible, and in cases of astigmatism they should be marked so that the axis may be correctly set. Any good optician will do this at small expense.

HERBERT S. RYLAND.

9 Alwyne Square, Canonbury Park, N., May 14.

NATURAL HISTORY AND SPORT.[1]

(1) IT is now six years since the publication of Captain Shelley's great monograph of the birds of Africa was suspended by the illness that overtook and ultimately proved fatal to the author. Fears, however, that the work might remain unfinished were happily allayed by the announcement that Mr. W. L. Sclater had undertaken to carry it on to completion. Several years elapsed before the final arrangement could be made, and it was not until 1912 that Mr. Sclater was able to bring out the volume under notice, which deals with the Lanii or drongos and shrikes, and is the second part of the fifth volume. This part is in every way up to the standard of its predecessor, and shows that Captain Shelley could not have committed the task to more competent hands than those of Mr. Sclater, who has a genius for systematic ornithology. The book would certainly have been improved and its cost not greatly increased by the addition of a few outline figures in the text to illustrate some of the structural characters of the birds; but the eight coloured plates drawn by that competent draughtsman and greatly improved bird-artist Mr. A. Grönvold are excellent. Apart from the systematic descriptions and the useful analytical identification keys, a full account of the known distribution of every species is given, and its habits, where observed, have been duly recorded.

(2) As director of the museum at Port Elizabeth, Mr. F. W. Fitzsimons has had exceptional opportunities of studying the snakes of South Africa, and his volume is the outcome of observations, extending over many years, upon these reptiles both in their native haunts and in captivity; and, thanks to his freedom from the restrictions imposed in some other countries, he has been able to make a long series of experiments upon the venom of the poisonous species. These experiments have shown, amongst other things, that none of the snake-killing mammals and birds of South Africa, like the mongooses, zorillas, hedgehogs, and secretary birds, is immune against snake venom, as has been stated and is often believed, but that one and all owe their ability to escape from and overcome even such redoubtable antagonists as the puff-adder and yellow cobra either to their extreme quickness in warding off or avoiding the stroke or to their protective armature. The experiments have also convinced Mr. Fitzsimons that the antivenene recommended by Dr. Martin and Major Lamb "by no means possesses the high standard of venom-killing power some people claim for it." These are only samples of the interesting matter contained in the volume, which is a medley of varied information, anecdotes relating to habits and field experiences being sandwiched between technical diagnoses of genera and species, often taken verbatim from the British Museum catalogue, the whole subject-matter being presented in such a manner as to make a volume both useful to the specialist and readable to the ordinary layman.

(3) The tale of Mr. Sutherland's ten years' adventures as an elephant-hunter in Portuguese and German East Africa is told with a simple charm and ease of style which give his volume a foremost place amongst books of African sport; and the interest of his experiences, some of them unique and most of them exciting, is heightened by the knowledge that he met them single-handed, with only one or two trusted natives to act as trackers and carriers. So vividly are the scenes depicted that on regretfully turning the last page one cannot but echo the sentiment of the author when he writes: "After so many years of a wild, free life, I find it difficult to accommodate myself to the stuffiness and constraint of a modern city; I prefer the forest to the imprisonment of streets, the twinkling stars to lamps, the sigh of the primitive forest to the tramp of thousands of human feet."

[1] (1) "The Birds of Africa." Comprising all the Species which occur in the Ethiopian Region. By P. E. Shelley. Vol. v., part ii., completed and edited by W. L. Sclater. Pp. viii+165-502. (London: H. Sotheran and Co., 1912.) Price 31s. 6d. net.

(2) "The Snakes of South Africa." Their Venom and the Treatment of Snake Bite. By F. W. Fitzsimons. New edition. Pp. xvi+547. (Cape Town and Pretoria: T. Maskew Miller; London: Longmans, Green and Co., 1912.) Price 12s. 6d.

(3) "The Adventures of an Elephant Hunter." By J. Sutherland. Pp. xix+324. (London: Macmillan and Co., Ltd., 1912.) Price 7s. 6d. net.

(4) "Baby Birds at Home." By R. Kearton. Pp. xv+128. (London: Cassell and Co., Ltd., 1912.) Price 6s.

From repeated encounters with African big game of all kinds, Mr. Sutherland concludes that the pursuit of the elephant is beyond doubt the most dangerous. Next come buffaloes and lions, which are about on a par; but it will surprise many of his readers to learn that the risk in shooting rhinoceroses is very small, smaller indeed than that attending the shooting of leopards. The volume is not, however, devoted wholly to sport. It contains much valuable information about the superstitions and social organisation of the natives, as well as harrowing descriptions of inter-tribal raids, throwing a lurid light on the life of uncivilised man.

Kom-Kom: the terror of Nagoromenia's kraal. From "The Adventures of an Elephant Hunter."

(4) "Baby Birds at Home" is a book for children. It is written in suitable style, but its chief merit is perhaps the excellence of the photographs with which it is illustrated. R. I. P.

THE PRODUCTION OF APPARENT RELIEF BY "KINOPLASTIKON."

AT the Scala Theatre—the home of "Kinemacolor"—there is now being exhibited a new feature, termed "Kinoplastikon," which is advertised as "singing, talking, moving, picture figures without a screen," and has been described in notices in the daily Press as stereoscopic. We visited the theatre recently in order to see this display and discover, if possible, how the stereoscopic effect was produced. We hoped to see some new optical principle illustrated, but in this we were disappointed.

After a number of the now well-known colour films had been exhibited there was a short interval, and then the curtain drew up, showing the stage set as an ancient temple, with two rows of columns and a background. This was all decorated in quiet colours such as brown and terracotta, and was only feebly lighted. Two attendants brought on a pair of tables, set them between the back pair of pillars and retired. Then two somewhat ghostly pierrots, dressed in white, appeared to come on the stage, and to play a xylophone duet on instruments on the tables. A gramophone produced the music and kept time with the movement of the players.

The optical effect appears to be produced by a variation of the old "Pepper's Ghost." A huge sheet of plate-glass—it must be 20 to 30 ft. square—seems to be set up in a vertical plane, making an angle of 45° with the front of the stage, so that any brightly lighted object on the left of the stage, as seen from the auditorium, may be seen by the audience by reflection as if it were upon the stage itself. A diagram will make the arrangement clearer. MN is the front of the stage, AB the background. CD, EF, GH, the pillars of the temple. GL is the sheet of glass. Then a bright object at PQ will be seen by the audience at XYZ as though it were at P′Q′.

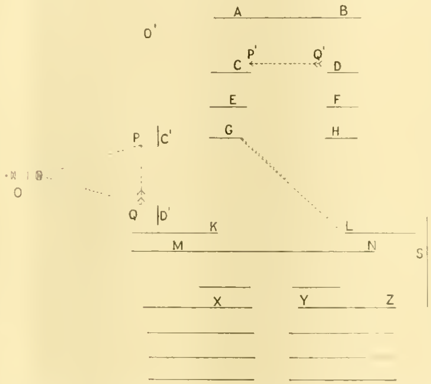
The figures are apparently projected by an animatograph O upon a semi-transparent screen at PQ.[1] Stray light from the lantern coming through the screen could be seen shining

[1] In order to avoid the great length from O to the centre of the stage, it is probable that the lantern is placed to shine down from above, or up from below, or even forwards from O, a silvered mirror reflecting the light into the required direction.

on the theatre wall at S. As only the figures themselves were seen, the rest of the screen must have been dark, and therefore the background of each picture must have been painted out on the film with black (unless the film was unusually opaque). This painting out would account for the absence of the "rain" effect of the usual animatograph reproduction.

It is obvious from the foregoing that there is no stereoscopic effect in the strict sense, *i.e.* that there is no difference between the picture seen by the right eye and that seen by the left eye, at least so far as the figures are concerned. But as the picture is a long way back on the stage (some 40 ft. or more), so that the difference between the pictures that should be seen by the two eyes would be quite small, and as the temple itself is of course in relief, there is no difficulty in imagining the figures to be in relief also; indeed, as they step backwards and forwards the illusion is very complete.

Some parts of the glass were unfortunately



badly out of parallelism, and when the reflection occurred at these places a doubling of the image was produced, which made the figures very indistinct; this, of course, cannot be avoided in such a large sheet of glass. Some other defects that we noticed could have been avoided. For instance, the image of the edge of the screen PQ did not quite coincide with the pillars CD; so that when the figures walked off the stage they disappeared before they reached the pillars. Apparently the image P′Q′ is a little behind the plane CD (for this defect was more evident at X than Z); if so, a pair of pillars C′D′ should be so placed in front of PQ as to form an image exactly coincident with CD. Then, wherever the image was viewed from, this parallax would disappear. We also noticed that the barrel in one item, which was placed on the stage, was not quite the shape or size of the one in the picture. The upper part of a pillar at B was rather brighter than the rest of the background, and could occasionally be seen through the figures. It should be painted a little darker.

ERADICATION OF PLANT DISEASES.

THE general assembly of the International Institute of Agriculture in session at Rome has wisely refrained from extending the Phylloxera Convention to all cases of plant diseases. Signor Cuboni's report on the diseases of plants and the best method to prevent their propagation gave rise to a lively discussion, but it was felt that rough-and-ready measures would do more harm than good. Ultimately a memorandum was adopted conveying the following recommendations:—

(1) The establishment of a Government service of phytopathology by all Governments of countries adhering to the International Institute of Agriculture.

(2) The convening at an early date of an international conference of specialists with the view of arriving at an international agreement upon the means of preventing plant diseases. The wish was expressed that the French Government would follow up the initiative it has already taken by calling such a meeting.

(3) At each general assembly of the institute the specialists of the various Governments should meet in a separate commission to discuss the results of their researches and studies on the diseases of plants.

(4) Countries adhering to the International Institute should at once begin to study the various questions which the International Commission of Phytopathology will have before it, basing their study upon the materials which the International Institute of Agriculture will be able to furnish.

The subject is one for concerted action. The study of plant diseases is not a simple one. It concerns the entomologist and protozoologist as well as the botanist, and among botanists not merely the students of fungi or bacteria, but the physiologist and the investigator on Mendelian lines; for the production of disease-resisting forms is one of the surest ways of eliminating the disease-factor. Furthermore, periodical meetings of the workers in these various fields of investigation will tend to encourage the worker, and will ensure that the results of the work are put to the best advantage. Comparison of results obtained in the same line of research under the various conditions offered by different countries will be specially helpful; and if international legislation is to follow, these various conditions must be carefully considered.

It should be obvious also that an organised service of phytopathology is an essential, and an *ad hoc* training of experts is a prime necessity. The study of plant diseases offers ample scope for investigation, and a Government service would find work for a supply of experts at home and abroad. One example will suffice. The Jamaica banana industry has been recently threatened with disaster because the Department of Agriculture had no expert in plant diseases to recognise on its outbreak a well-known disease which had already caused serious loss to the same industry in Central America.

NOTES.

At a meeting on Monday, May 19, the council of the Royal Society of Arts passed the following resolution:—"On the occasion of the fiftieth award of the Albert medal of the Royal Society of Arts, the council of the society desire to offer the medal to H.M. King George V., for nine years president, and now patron of the society, in respectful recognition of his Majesty's untiring efforts to make himself personally acquainted with the social and economic condition of the various parts of his dominions, and to promote the progress of arts, manufactures, and commerce in the United Kingdom and throughout the British Empire." The Albert medal was established in 1862 as a memorial of H.R.H. the Prince Consort, who had been president of the society for eighteen years. It is awarded annually for "distinguished merit in promoting arts, manufactures, or commerce." In 1887 it was awarded to Queen Victoria on the occasion of her jubilee, and in 1901 to King Edward VII., when, on his accession to the throne, he relinquished the presidency of the Society of Arts, which he had held for thirty-eight years.

Mr. Edwin Tate has just made a donation of 10,000*l.* to the Imperial Cancer Research Fund, for the endowment of the research.

Mr. H. H. Law has been appointed chief engineering inspector to the Local Government Board, in succession to Mr. G. W. Willcocks, C.B., retired.

The King has appointed Commander E. R. G. R. Evans, R.N., a Companion of the Order of the Bath (C.B.), in recognition of his services with the British Antarctic Expedition, 1910–12.

Prof. Bateson's postponed lectures on the heredity of sex and some cognate problems will be delivered at the Royal Institution on Monday, June 2, and Wednesday, June 4, at three o'clock.

The Berlin correspondent of *The Times* announces that Prof. H. Weber, professor of mathematics at Strassburg University since 1894, died on May 17 at seventy-one years of age.

We learn with regret that Dr. Lester F. Ward, professor of sociology at Brown University, Providence, R.I., and formerly palæontologist of the U.S. Geological Survey, died in Washington on April 18, in his seventy-second year.

The fifty-eighth general meeting of the Institution of Mining Engineers will be held on Thursday, June 5, at 11 a.m., in the rooms of the Geological Society, Burlington House, Piccadilly, London, W. The institution dinner will be held at the Waldorf Hotel on the evening of the same day.

We learn from *Science* that a tablet in honour of Dr. S. P. Langley was unveiled in the Smithsonian Institution on May 6. Addresses were delivered by Dr. Alexander Graham Bell and Dr. J. A. Brashear. At the same time Langley medals were awarded to M. Gustave Eiffel and Mr. Glenn H. Curtiss. Later in the day the Aëro Club of Washington arranged an aviation display in the grounds of the Army War College in honour of Dr. Langley.

The Paris correspondent of *The Times* announces the death of M. Alfred de Foville, perpetual secretary of the Académie des Sciences Morales et Politiques. M. de Foville, who was in his seventy-second year, was one of the most eminent political economists and statisticians of his day. From 1877 to 1893 he was chief of the Department of Statistics and of Legislation in the Ministry of Finance, and for a time he concurrently occupied the chair of industrial economy and of statistics at the Conservatoire des Arts et Métiers.

An influential international committee has been formed to endeavour to establish a uniform notation in the theories of potential and elasticity. The committee has already sent out a circular to all those likely to be interested in the subject asking what are the notions and notations with respect to which uniformity is desirable. Discussions on the subject will be arranged to take place at the international congresses of mathematicians in 1916 and 1920, and it is hoped that the final report of the committee will be issued in 1921.

The series of British land and fresh-water shells in the British Museum (Natural History) has received an important addition in the shape of a large collection brought together by Mr. F. H. Sikes, of Burnham Abbey, Burnham, Bucks, who has presented it to the nation, on condition that it shall be exhibited in the public galleries. The collection includes specimens from the cabinets of Messrs. Cairns, Fitzgerald, Grateloup, and Rogers, and is reported to be of special value on account of the care with which the less common species and subspecies have been named. The collection has already been received at the museum.

A message from the Paris correspondent of *The Times* states that the Congress of the Royal Institute of Public Health was opened on May 16 at the Sorbonne in the presence of a number of eminent French and English men of science. The Under-Secretary of State for the Interior, M. Paul Morel, welcomed the members of the congress to Paris on behalf of the Government. Prof. W. R. Smith said, in reply, that the holding of the congress in Paris was a further proof of the closeness of the relations existing between the country of Lister and the country of Pasteur. Speeches were also made by Prof. Landouzy, president of the French section of the congress, Sir Thomas Oliver, who is president of the industrial section, and the Lord Provost of Glasgow. At the close of the meeting Prof. Smith handed to Prof. Roux, director of the Pasteur Institute, the gold medal of the Royal Institute of Public Health.

An impressive collection of photographs of scenes connected with Capt. Scott's ill-fated Antarctic expedition is reproduced in yesterday's *Daily Mirror*, May 21. The pictures include a striking view of the cairn, surmounted by a cross, erected over the tent where the bodies of Capt. Scott, Dr. Wilson, and Lieut. Bowers were found; photographs of the explorers on skis dragging their sleigh towards the south pole, and standing near Amundsen's tent, which they found upon arriving at their goal; the last photograph of the party of five taken at the pole; and the tent in which Capt. Scott and his two companions waited until the icy hand of death relieved their sufferings. When the search party found the tent, it was nearly buried in snow, and in a few months all trace of it would have disappeared. All the illustrations are remarkably fine, and they serve to show the nature of the region near the south pole, as well as to stimulate pride in human endeavour.

CAPT. J. K. DAVIS, commander of the *Aurora*, the vessel attached to Dr. Mawson's Australasian Antarctic Expedition, reports the results of his endeavours to relieve the two parties in January and February of this year. He had already visited the main party, and taken part in the search for Dr. Mawson himself and his two companions, Ninnis and Mertz, whose tragic loss has already been reported. Prevented by bad weather from taking off this party, Capt. Davis was forced to leave them in order to hurry to the relief of the other, under Mr. F. Wild, 1500 miles westward of Commonwealth Bay. These men were found all well, and were taken off just in time to escape the closing ice, though the ship did not escape very severe weather on the return to Hobart. Some anxiety must be felt for the main party: Dr. Mawson himself, by travelling alone for twenty-two days, bereft of his two companions, has undergone an experience scarcely less terrible than that of any of his predecessors in polar exploration, but the base is well equipped. The wireless telegraphic station on Macquarie Island maintains communication between the base and Australia, and is signalling daily weather reports, while among other scientific work, sufficient soundings for a section of the ocean bottom between Hobart and the Antarctic are mentioned by Capt. Davis. He himself is visiting England with the especial and laudable purpose of raising funds to aid the cost of the prolonged stay of the main party in the south polar region.

THE President of the Local Government Board has authorised the following special researches to be paid for out of the annual grant voted by Parliament in aid of scientific investigations concerning the causes and processes of disease:—The causes of premature arterial degeneration, Dr. F. W. Andrewes; insects in relation to disease (Prof. Nuttall, F.R.S., on the life-cycle of the body louse and bug; Dr. Bernstein and Mr. Hesse on the *Empusa muscae* in flies); infantile diarrhœa, Mr. F. W. Twort and Dr. Edward Mellanby; the virus of poliomyelitis, Drs. Andrewes and M. H. Gordon; the character and life-history of certain filter-passing micro-organisms, Mr. F. W. Twort; respiratory exchange in man under varying conditions, Prof. Leonard Hill, F.R.S.; the biochemistry of syphilis, Mr. J. E. R. McDonagh; the possibilities of serological diagnosis of scarlet fever, Dr. L. Rajchman; the relation between the clinical symptoms and the bacteriology of the acute respiratory affections, Dr. D. M. Alexander.

A CABLEGRAM has been received at Bishop's Stortford from Bangalore, announcing the death, from snakebite, at the early age of thirty-seven, of Mr. Herbert Kelsall Slater, geologist to the Mysore Government. Mr. Slater was educated at Bishop's Stortford College, which he left in 1894. After spending the next seven years at Bangalore with his father, the Rev. T. E. Slater, he was sent in 1901 to the Royal School of Mines, where he studied geology under Prof. Judd. On the recommendation of Mr. Foote, he was appointed in 1902 geologist to the Mysore Government, for which he did much valuable work. The results of his work are given in the records of the Mysore Geological Department (see NATURE, vol. lxxviii., p. 470). He surveyed and mapped large districts, and among important ores which he found to be widely distributed are gold and manganese ores. He also discovered and described important felsite and porphyry dykes; and the palace of the Maharaja is built from stone discovered by him. He spent December to May each year in prospecting, and it was while camping on one of these expeditions in the district of Shimoga that he met with the accident that caused his death. Not long ago Mr. Slater spent about six months in a tour in Canada in order to gain additional light upon his sphere of work in India by the study in the field of great Archæan complex.

THE work of the British School of Archæology in Egypt this winter, under the personal direction of Prof. Flinders Petrie, has been attended with some interesting results. At the close of the last season's work a first dynasty cemetery had been partly excavated at Tarkhan, about forty miles south of Cairo, and this year the site has been systematically worked; eight hundred graves, grouped on each side of an axial road, have been carefully cleared and studied, and much pottery and strings of carnelian, garnet, and blue-glazed beads have been recovered. The damp of the valley in which the cemetery lies has prevented the removal of the bones, but these were all carefully measured, and some seventy of the skulls, preserved by solidifying with paraffin wax, will be brought to England for further study. The new material thus obtained will be a valuable supplement to the careful and exhaustive collections made by the American excavator, Prof. Reisner, mainly in Upper Egypt, and published, with Prof. Elliot Smith's collaboration, two or three years ago. Meanwhile the excavators interpret the new evidence as proving the existence at Tarkhan of the conquering tribe of the dynastic people of ancient Egypt, who had advanced northward from Abydos, subduing the Nile Valley, until Mena founded the new capital of United Egypt at Memphis. It is interesting to note that, according to the discoverers, the men of the dynastic race were an inch or two shorter than the indigenous population; and this supports the persistent native tradition that the conquerors owed their success to superiority in armament rather than in physical qualities. At Gerzeh, another site a few miles further south, some interesting finds were also made, dating from the twelfth and eighteenth dynasties, the most remarkable being a gold pectoral inlaid with coloured stones, like the celebrated Dahshur jewellery.

MR. E. W. DEMING gives, in *The American Museum Journal* for March, an interesting account of the scheme now being undertaken to prepare, on the walls of the museum, a series of panels illustrating the life of the American Indians. Each panel will tell the story of the life of a particular stock—their mode of living, customs, decoration of their lodges, life in the tipi, transportation, in short, all the minor details which will give colour and reality. The general control of the work rests with Mr. Deming, who has lived for some fifty years with various Indian tribes. He will utilise the material collected by Mr. Louis Akin, a skilled painter, who was received as a member by the Hopi tribe, and unfortunately died at Flagstaff, Arizona, in January last. His untimely death, at the age of forty-five, is a serious loss to American art and anthropology.

The National Geographic Magazine for March publishes an article by the late American Minister to Guatemala, Mr. W. F. Sands, on the prehistoric ruins of that country. This is the preface to an account by Mr. S. G. Morley, assistant director of the Quiriqua Expedition of 1912, of the excavations at this place, situated fifty-seven miles from the Caribbean Sea. It was one of the early centres of the Maya civilisation, which flourished in south Mexico, Guatemala, and north Honduras during the first fifteen centuries of the Christian era. The place was unknown since Hernando Cortez passed within a few miles of it in 1525. A series of temples has now been disinterred containing many interesting carvings and hieroglyphs, the interpretation of which is still, in a great measure, unknown. So far the excavations are merely tentative. But the School of American Archæology proposes to pursue the work, which cannot fail to throw much new light on the problems of Maya culture.

The Palæolithic skull from Piltdown, Fletching, Sussex, just described in the Quart. Journ. Geol. Soc. by Dr. A. Smith Woodward as the type of a new genus and species (*Eoanthropus dawsoni*), has been placed on exhibition in a special case in the central hall of the Natural History Museum.

According to the report for 1912, work at the Sarawak Museum has been somewhat interrupted by the absence on leave of the curator; it is hoped, however, that this will be more than compensated by the information acquired during his visit to Europe. A strenuous effort is being made to place on exhibition a mounted series of the local birds.

In the May issue of *The Selborne Magazine* it is announced that the Selborne Society now possesses no fewer than ninety-five editions of Gilbert White's "Natural History of Selborne," and even this is believed not to exhaust the list. On another page Mr. Rashley Holt-White writes to express his belief that the print recently declared to be a portrait of the Selborne naturalist is not correctly identified.

The recently published report of the advisory committee for the Tropical Diseases Research Fund for 1912 shows, as usual, great activity in research in the schools, universities, and laboratories at home and in the Colonies, supported by pecuniary contributions which can scarcely be considered creditable to a great Empire. The total revenue of the fund for 1912 was 3425*l.*; the expenditure was 3833*l.* 6*s.* 8*d.* The excess of expenditure over income was met by drawing on the accumulated balance of the fund, and it was necessary to warn the schools of tropical medicine that it would not be possible to repeat in 1913 grants on the same scale. Appended to the report of the committee are those of the professor of protozoology in the University of London, the Quick Laboratory, Cambridge, the London and Liverpool Schools of Tropical Medicine, and of seven Colonial laboratories. As usual, these reports describe many important investigations, especially in the transmission of parasites and the causation of disease, which it is to be hoped will find their way also into the ordinary channels of scientific publication, where they will be less likely to be overlooked.

In *The New Phytologist* for February (vol. xii., No. 2), Mr. H. Takeda gives an interesting general account of the vegetation of Japan, which has also been issued as a reprint (Wesley and Son, London, price 1*s.*, post free). The author describes the geographical features and climate of Japan, laying special stress on the influence of the warm and cold currents which wash the shores of the long chain of islands composing the Japanese Empire, and exert a marked influence upon the vegatation, as well as on the great variety of climatic conditions which obtain owing to the fact that the islands extend over thirty degrees of latitude —the southernmost islands being subtropical, while the most northerly have a climate like that of Nova Scotia or Iceland, the harbours being blocked by drifting ice from November to April. He then describes the various plant formations occurring in the northern, middle, and southern regions, into which, for convenience, the country is divided from the phytogeographical point of view, with numerous examples illustrating the range from arctic through subarctic, cold temperate, warm temperate, and subtropical to tropical types of vegetation. The vertical zonation of the vegetation on the higher mountains is illustrated by a description of the plant communities seen on ascending Mount Fuji. The paper also contains a discussion of the origin and affinities of the Japanese flora, and short accounts of the cultivated crops and of the introduced and garden plants.

A paper recently presented to the Royal Geographical Society by Lieut. H. A. Edwards gave a very clear idea of the important character of the survey work of the commission on the northern boundary between Bolivia and Brazil, in 1911 and 1912. The work is to be continued, but already a considerable area, previously unmapped and practically unknown, has been covered between the sources of the Bahia and Rapirran rivers. In 1911 a primary station was established on the latter river, which was then followed and mapped up to its source, after which the British commissioners, without their Brazilian colleagues, crossed the watershed to the valleys of the Abuna and Xipamanu. In 1912 the boundary line following the River Acre was mapped from Cobija to Tacna, and a party crossed to the Bahia, and thence to the confluence of the Ina and Xipamanu, from which point the Riparran was again visited, and a junction effected with the starting point of the work of the preceding year. A general description of the country, with facts concerning its geology, climate, flora, and fauna, was furnished by Lieut. Edwards, and some idea as to the extreme difficulties attendant upon exploration, and particularly upon careful survey, in this region, was afforded by his account. Progress, whether along the rivers or through the forests, meets with continual opposition from nature in one form or another; insect pests attack the travellers and their animals, and food supplies are often far from easy to keep up.

THE measurements made last year by Prof. McClelland and Mr. Kennedy of the number and mobility of the large ions present in the atmosphere cast some doubt on the generally accepted interpretation of the records of the various types of instruments intended to measure the ionisation in the atmosphere at any time. The number of small ions of mobility about 1·6 cm. per second in a field of 1 volt per cm. may be taken as 1500 per c.c. in normal circumstances, while the authors find that the air of Dublin has in it about ten times as many large ions of mobilities of the order of 1/3000 cm. per second. There is strong evidence that they consist of a nucleus, originally uncharged, which attracts to itself one of the small, more mobile ions. The nucleus itself probably consists of an invisible drop of water, which it is known may exist in air even when the air is unsaturated. Further investigation is, however, necessary before the absence of ions of intermediate sizes can be satisfactorily accounted for. The description of the methods of measurement adopted will be found in the December, 1912, number of the Proceedings of the Royal Irish Academy.

IN No. 15 of the *Revue Scientifique* is published an address delivered by Prof. Victor Grignard on the occasion of the presentation to him at Stockholm of the Nobel prize. In this address he gives a brief summary of the different types of synthesis by means of magnesium, with which his name is associated, and which have led to extremely fruitful developments in the domain of organic chemistry. During the past ten years no fewer than seven hundred papers have appeared dealing with the "Grignard reaction," whilst in practice it has found important application in the commercial synthesis of such drugs as stovaïne and alypine, which have many advantages over cocaine, and of many compounds of importance in perfumery.

WE have received from the Agricultural Experiment Stations of the Louisiana State University a copy of Technical Bulletin No. 135, which contains a report of investigations carried out by Dr. W. E. Cross and others on methods of analysis of sugar-cane products. The report includes a number of papers, of which the following are the most important:—The determination of dry substance by means of the refractometer; the application of dry basic lead acetate defecation to sugar-house analysis; a rapid method for the estimation of glucose in juices; a modification of the Clerget method of determining glucose in molasses; the effect of urea and betaine on the rate of inversion of cane-sugar by hydrochloric acid; and the direct estimation of cane-sugar in presence of reducing sugars. Useful tables are appended to the report.

IN the current number of the *Comptes rendus* (May 13), Ph. Barbier and R. Locquin give a new method for stepping down the series of the fatty acids. Starting with the acid $R.CH_2.CO.OH$, they convert this into the methyl (or ethyl) ester, and treat this with two molecules of magnesium methyl iodide, forming the tertiary alcohol $R.CH_2.C(OH)(CH_3)_2$. This, or the hydrocarbon $R.CH=.C(CH_3)_2$ formed by dehydration, on oxidation with chromic acid, gives acetone and the acid $R.CO_2H$, the next lower homologue of $R.CH_2.CO_2H$. The ketone $R.CH_2.CO.CH_3$ may also be used as the starting point for the production of the same acid, $R.CO_2H$. The reaction is a general one, and can be applied with success to dibasic acids; thus β-methyladipic acid gives methyl-succinic acid.

A LECTURE on the economics of engineering, delivered by Major W. J. A. O'Meara, C.M.G., at Faraday House, on February 26, has reached us in the form of a reprint from *The Royal Engineering Journal* for April. It is an excellent thing that the application of the principles of economics to individual trades should be considered, and Major O'Meara has done well to choose that of engineering for his lecture, since it plays so important a part in the production of the national wealth. He confines himself largely to electrical engineering, and deals mainly with the efficiency of management and organisation. He also deals shortly with the question of markets, showing the special and peculiar conditions attaching to this branch of the industry, and just touches very briefly on one or two other points. The main question treated in his lecture is divided into three sections—organisation, management, and technical aspects—and each of them is considered in reference to the conditions which conduce to the maximum efficiency. The former, for instance, deals with the establishment of a "direct chain of command" among those responsible for the work, the proper choice of officers for the various departments, the proper subdivision of the work, to render possible among other things the easy ascertainment of the costs of each class of work. Technical aspects, again, include economy in materials, design, the operating of plant, and methods of execution, in connection with which the necessity of avoiding, so far as possible, the dismissal of skilled workmen is forcibly urged. Indeed, brief though it is, the paper is highly suggestive, and arouses the hope that in the future Major O'Meara will give us a full and detailed treatment on these lines of the whole engineering trade.

SOME novel towing tests conducted at the experimental tank in the Navy Yard at Washington form the subject of an illustrated article in *The Engineer* for May 16. The questions to be investigated were whether existing piers in the Hudson River should be lengthened to meet the demands of bigger liners, and also to settle the problem of granting renewed permission for the continuance of two temporary extensions of 100 ft. each beyond the pierhead line approved by the Secretary of War in 1897. These questions involved the reproduction in the tank of both shore lines of the Hudson River throughout the berthing section of the big Transatlantic steamers, and the models towed represented those ships now in service as well as a yet unbuilt craft 1000 ft. long. Suction was investigated by means of floating models and submerged buoys. The movements of these during each run of the towed model were recorded by use of moving-picture cameras, so situated that every essential movement could be caught. An index finger moving over a dial on the towing carriage showed the position of the model at every instant. While the full results are not yet published, it may be noted that the Government authorities have again refused permission for the temporary pier extensions to be made permanent.

Under the title of "The Land of the Blue Poppy," the Cambridge University Press will shortly publish Mr. F. Kingdon Ward's record of his experiences and observations while engaged in plant-collecting in western China and south-eastern Tibet during the year 1911. The book is dedicated to the memory of the author's father, Prof. H. Marshall Ward.

Messrs. Witherby and Co. have been appointed European agents for *The Emu*, the organ of the Royal Australasian Ornithologists' Union, and copies of that publication can now be obtained at 326 High Holborn, London, W.C.

OUR ASTRONOMICAL COLUMN.

Comet Gale (1912*a*).—An ephemeris for Gale's comet (1912*a*) is given in the *Astronomische Nachrichten*, No. 4651, by Herr M. Ebell, of Kiel, but the object is very dim, being fainter than magnitude twelve. It was observed on April 26 in Uccle by G. van Biesbroeck, and in Bothkamp by Dr. H. H. Kritzinger, and, according to the former, the ephemeris was in error by -3s. and $+1{\cdot}5'$. Dr. Kritzinger describes the comet as an elliptical nebula $1'$ and $0{\cdot}7'$ diameter, the brightness of the nucleus being 12·8 mag., the total brightness amounting to 12·5 mag. In answer to a telegram sent to Algiers, Herr F. Gonnessiat reports that on May 2 the comet was on the extreme limit of visibility.

The ephemeris up to the end of this month is as follows:—

	α true h. m. s.	δ true ° ′	Mag.
May 22	6 53 30	+45 44·5	—
24	6 55 59	45 27·7	12·6
26	6 58 26	45 11·2	—
28	7 0 53	44 55·1	—
30	7 3 18	44 39·3	—

The Spectra of Spiral Nebulæ and Globular Star Clusters.—Dr. E. A. Fath has been continuing his discussion of the spectra of spiral nebulæ and globular star clusters secured with spectroscopes attached to the 60-in. reflector of the Mount Wilson Observatory; his latest results appear in the April number of *The Astrophysical Journal* (vol. xxxvii., No. 3, p. 198). The spiral nebulæ here investigated are seven in number, the exposures ranging from 7h. 40m. to 38h. 14m., while the total exposures for each of the four clusters ranged from 13h. 5m. to 16h. 17m. In the case of the nebulæ they for the most part exhibit the spectra of solar type stars, but he refers to two, namely N.G.C. 1068 and 4736, as peculiar, giving evidence of "gaseous" radiation. Up to the present he has investigated altogether twelve globular clusters, and the result so far shows that as a whole the brighter stars of the globular clusters have spectra ranging only from the F- to the G-type. Dr. Fath hopes that as the clusters observed are nearly all readily reached in latitude 34° north, some southern observatory will undertake the investigation of those south of $-20°$, to find out whether they also exhibit this small range of spectral type so striking a feature of the northern clusters.

Reports on Indian Observatories.—Dr. G. T. Walker, the Director-General of Indian Observatories, has just forwarded his reports for 1912 on the observatories of Kodaikanal, Madras, Bombay, and Alibag, accompanied by the reports of the several directors. In the case of the first-named. he directs attention to the energies of Mr. Evershed, to the transfer of the Poona instruments to Kodaikanal, and to the appointment of Mr. Royds. He states that a serious effort is going to be made to teach the assistants to undertake the measuring of the numerous photographs, which up to the present has only been done by the gazetted officers. He hopes further to make the observatory an ordinary second-class instead of a first-class meteorological station in order to free the fourth assistant for solar work. The transit instrument at Madras in the beginning of 1910 suddenly changed its level, and the occurrence was repeated in 1911 and 1912. As this had never taken place before, it was thought that underground water currents had affected the earth neighbouring the concrete foundation. This is now going to be investigated. and in the meantime the Madras clock will be rated by wire from Kodaikanal. No special features are mentioned regarding the other two observatories, unless the reference to the absence of trouble from white ants at the Colaba Observatory be noted.

"L'Astronomie" for May.—The current number of the *Bulletin de la Société Astronomique de France* contains the address delivered by M. Camille Flammarion on the occasion of the twenty-seventh year of the existence of the French Astronomical Society. The subject of his discourse was confined to the progress of the society, and the success that the society has achieved is well known this side of the Channel. A very valuable feature in the journal is a series of reproductions of all the past presidents of the society. On the same occasion M. Puiseux summarised the advances made in solar studies during the past year, and this will be found uselul to those not closely following the progress of solar physics. Other contents to which attention may be directed are "Les Photographies à poses variées," "Les Céphéides considérées comme Étoiles Doubles," "Comparaison d'un Chronomètre aux signaux rythmés," &c.

The Parallax of the Nebula G.C. 117=N.G.C. 221.—Dr. Gustaf Strömberg communicates to *Astronomische Nachrichten*, No. 4650, his results of the determination of the parallax of the nebula G.C. 117, or N.G.C. 221, which he secured at the Stockholm Observatory. This nebula lies in the region of the Andromeda nebula, like a satellite to it, and is much easier to measure than the nucleus of the large nebula. The plates which Dr. Strömberg measured were those that were used by Prof. Karl Bohlin for his determination of the parallax of the Andromeda nebula. In his measures Dr. Strömberg employed a comparison star in the neighbourhood of the nebula, the coordinates being Neb. (G.C. 117)$-*$: $\Delta\alpha = -11{\cdot}56$s., $\Delta\delta = -18{\cdot}3''$. The investigation embodied fifty determination of differences of R.A. and forty-six of differences of declination, and the parallax he secured was $+0{\cdot}073'' \pm 0{\cdot}055''$. Details of the research will be published later in the publications of the observatory.

TEACHING OF MATHEMATICS IN GERMANY.[1]

IN previous issues we have referred to papers on English education in mathematics which were laid before the 1912 International Conference on Mathematical Teaching. We have now before us, in five volumes, the German contribution to that conference. They give an account of mathematics at the primary and secondary schools, at the universities, in technical education, and in training colleges for teachers. They deal mainly with Prussia, but include also the non-Prussian parts of the German Empire, with an occasional reference to Austria.

Germany also has its reform movement in mathematics, and most of the changes that have been made lie to the credit of a body which bears the euphonious name of "der Damnu," into which its full title "Deutscher Ausschuss für den Mathematischen und Naturwissenschaftlichen Unterricht" has for the sake of brevity been telescoped. This body was formed in 1907, by the united action of a number of voluntary scientific associations, and is playing much the same part that the British Association committee has played in this country.

The aims and the present position of the movement are well illustrated by a scheme of teaching proposed by Dr. Schimmack for the Oberrealschule. The scheme covers the nine school years between the ages of nine and eighteen.

In geometry the scheme begins in the manner to which we are now accustomed in England, with measuring, drawing, practice with instruments, and work which familiarises geometrical concepts.

It is noticeable that there is two years' work in geometry before algebra is begun. This procedure, so excellent because of the more abstract and difficult nature of algebra, is not the result of the reform movement, but has long been the practice in Germany. It is a promising sign that the report of the curriculum committee of the Headmasters' Conference advocates this procedure, and gives us leave to hope that in this matter England will follow Germany's lead.

Algebra, then, is begun in the fourth school year, geometry having been begun in the second. It leads off well, with signless quantities, and it is rather a pity that the subject is not carried on for a year or so with such quantities before the distinction between positive and negative quantities is introduced.

The trigonometry of right-angled triangles is to be introduced in the sixth year, as is also "projective geometry" (or cross-ratio geometry). The former proposal would find much support in this country; the value of the second item is not so clear.

In the seventh year the calculus is begun, differential and integral at the same time, a proposal which many in England will approve. Not so many will, however, approve of Dr. Schimmack's relegation of arithmetical and geometrical series to their proper place beside the calculus.

The scheme closes with "discussion of the foundations of geometry," too metaphysical perhaps for most boys; but we must remember that the scheme is intended for the Oberrealschule, and that less ambitious schemes would be appropriate to the Gymnasium and Realgymnasium.

An important note is appended to the scheme to say that throughout the course geometrical figures are to be thought of as variable and not rigid, and that attention is to be directed to the interdependence of the parts as the form of the figure changes.

The consideration of this scheme goes to justify our English reformers in their view that they are not sacrificing thoroughness to the desire to cover ground. It is much that the Germans, with their love of beginning from the very foundations, should declare for "functional thinking" from the start, for the introduction of trigonometry at fourteen or fifteen, and of the calculus at fifteen or sixteen, and should feel it possible to prune the course sufficiently to allow that.

The language of these volumes is at times curiously heavy. One happens on long, long sentences the meaning of which cannot be extracted by ordinary reading; they have to be logically dissected. And such sentences are frequent. Is the accusation true that command of language is spoilt by a mathematical training? Or have the Germans spoilt their language by the replacement of foreign words by sesquipedalian words of home manufacture? Whatever the cause, these volumes contain also the germs of better things. "Der Damnu" has been referred to. "Die IMUK" is a portmanteau word for die Internationale Mathematische UnterrichtsKommission, and "Der DATSCH" for der Deutsche Ausschuss für Technische SCHulen. Some extension of this idea will quickly reduce the most unwieldy sentence to manageable size.

[1] "Abhardlungen über den mathematischen Unterricht in Deutschland-veranlasst durch die Internationale Mathematische Unterrichtstkommission." In twenty-five parts. Herausgegeben von F. Klein. (Leipzig and Berlin: B. G. Teubner, 1909-12.)

"Berichte und Mitteilungen veranlasst durch die Internationale Mathematische Unterrichtskommission." In four parts. (Leipzig and Berlin: B. G. Teubner, 1910-12.)

THE ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

THE annual conference of the above association was held at Bradford during Whitsuntide. The address of the president of the association (Mr. P. Coleman, Northern Polytechnic, London) dealt mainly with the organisation of technical education, the value of "internal" examinations for technical students as compared with "external" examinations, and the London University Commission report in its bearing upon polytechnic work. He remarked in reference to this:—

"The report and the recommendations based thereon unfortunately show a bias that can only be due to a complete misconception of the work and standing of the London polytechnics. . . . The reasons given in the report appear to be based on insufficient evidence, and at variance with the facts as known to those who have a close acquaintance with the polytechnics."

Mr. Coleman urged the development of "non-vocational courses in the technical schools, partly because in many towns these schools are the only suitable institutions in which to hold such courses for adult students (whether technical students or not), and also in order to bring home to students whose main interest is necessarily the study of science or technology that "the work associated with their future occupation should not lead them to forget every other means of culture." As a practical measure in this direction, he suggested that the technical institutions "should definitely associate with themselves the University Extension Lectures of the locality, or such work as that of the Workers' Educational Association."

Papers were read to the conference upon vocational education, by Mr. Arthur C. Coffin, director of education, Bradford; co-ordination within a county area, by Mr. F. W. Cook, chief officer for technical education for the West Riding of Yorkshire; and the corporate life of technical institutions, by Mr. W. Hibbert, Regent Street Polytechnic, London. A number of sectional meetings were held, attended by teachers of special subjects, at which questions such as the qualifications for the registration of teachers, the syllabuses and courses of work put forward by various examining authorities, and methods of teaching were discussed.

The principal resolutions passed by the conference dealt with the educational proposals of the Government, and the London University Commission Report. The conference urged the "necessity for improved provision for technical education and the organisation of technical education on a national basis." In addition, attention was directed "to the urgent necessity for increased grants from the State in aid of technical education," higher salaries for teachers to be a first charge upon these increased grants. With regard to the London University Commission report, a resolution was passed unanimously opposing any limitation of the existing facilities for obtaining external degrees, and the proposed exclusion of external students from the examinations in the faculty of technology, including engineering. This resolution also stated that many of the criticisms made in the report concerning London polytechnics and technical institutions are obviously founded on an incomplete knowledge of the work done in these institutions. The association strongly deprecated any weakening of the connection between these institutions and the University in view of the excellent results which have followed in the past as a result of the present relationships between the polytechnics and the University. The higher work in these institutions, whether day or evening, should form an integral part of the organisation of the faculties of science and technology.

A public meeting was held in connection with the conference in the large hall of the Bradford Technical College, the principal speaker being the Right Hon. J. A. Pease, M.P., the President of the Board of Education. During the course of his speech, Mr. Pease emphasised the importance of technical education, especially in the day-time if possible, and the necessity of "gradually bringing into the educational net nearly the whole of the population which left school between the ages of twelve and fourteen." New regulations would shortly be issued which, by means of larger grants and more elastic conditions, would favour the development of junior technical schools, "which would be linked up with the colleges and classes of a superior character." Mr. Pease criticised external examinations "as a waste of money and effort, and resulting in very little good." In concluding, he suggested that the key of the educational situation is to give more power, coupled with greater financial aid from the State, to the local authorities.

J. WILSON.

THE NATIONAL PHYSICAL LABORATORY.

THE annual meeting of the general board of the National Physical Laboratory was held recently at the rooms of the Royal Society, when the report and accounts for the year 1912 and the statement of work for 1913 were presented and approved for transmission to the president and council of the Royal Society.

In former years this meeting has usually been held at Teddington during the month of March, and has been combined with an inspection of the laboratory by the members of the board. In consequence of a change in the financial year, the annual inspection will in future be held at a later date. This year it is to take place on Thursday, June 26, when the Right Hon. A. J. Balfour will open the new buildings recently erected.

These buildings complete a scheme initiated in 1909 to provide laboratories for metallurgy and optics, with administrative offices, at an estimated cost of 30,000*l.*, exclusive of equipment; of this sum the Treasury undertook to provide 15,000*l.*, provided the remainder were forthcoming from other sources.

In 1910 the late Sir Julius Wernher generously provided 10,000*l.* for the erection of the metallurgy laboratory, and on learning lately that the actual cost had exceeded the sum available by 930*l.*, Lady Wernher most kindly defrayed the deficit.

To secure the further sum necessary for the completion of the scheme, and to obtain funds for the equipment of the buildings, an "Additional Funds Committee," of which the late Sir William White was chairman, was appointed during 1912. In its report this committee states that the Royal Commissioners for the Exhibition of 1851 had generously given a donation of 5000*l.* to the building fund, thus completing, with the gift from Sir Julius Wernher, the 15,000*l.* required to meet the Treasury grant.

Generous help towards the equipment has been received from many sources, including a number of the City companies. The committee, however, points out that considerable sums are still necessary to provide adequately the equipment which is essential for the proper development of the work.

The block of buildings for optics and administration is now nearly complete, and it is to open these that Mr. Balfour has promised to be present on June 26.

ATMOSPHERIC REFRACTION IRREGULARITIES.

THE anomalies of atmospheric refraction are numerous, and at various times irregularities extending over periods of one minute, one day, and one year have been discussed, that of the order of one second being generally known and causing "unsteady seeing." The variation of the order of one minute was discovered by Nusl and Fric experimentally in 1908, and they concluded that this irregularity had an amplitude of nearly a second of arc. The existence of such a large amplitude and its importance in meridional work suggested to Prof. Frank Schlesinger a redetermination by a perfectly independent method, and this he has done and described in a recent number of the Publications of the Allegheny Observatory (vol. iii., No. 1). He has based his measures on photographs of ordinary star trails made with the help of stationary long-focus instruments, and these he has had secured for him, according to a programme, by Prof. Slocum with the 40-in. Yerkes refractor, and Prof. Seares with the Mount Wilson 60-in. reflector, the star trails being those of the Pleiades group. The result deduced from the Yerkes plates, as is illustrated by curves in the publication, is to show the presence of this slow fluctuation, every one of the seven trails remaining at times above or below its mean position for a considerable fraction of a minute.

The same series of photographs was used to determine whether neighbouring stars showed the same fluctuations and whether the minor fluctuations were real. The curves plotted from these photographs thoroughly endorsed both these views, one figure showing the fluctuations of Merope and Alcyone as absolutely identical. To decide whether such one-minute fluctuations were common to mountain sites as well as low-lying situations, the Mount Wilson photographic trails were employed, and handled in the same way. The conclusion drawn was that the irregularities were of the same character, the amplitude being of the same order and the extreme range about one second of arc. Prof. Schlesinger thus directs attention to the fact that these results set a limit of accuracy to meridian work and show that photographic determinations of the distance between two widely separated objects are much more accurate than micrometer (excluding double image or heliometer) observations with the same instrument, because the former are affected alike, the same time element being common to each.

PROPERTIES AND STRUCTURE OF ICE.

An interesting account of a number of experiments by Prof. R. S. Tarr and Dr. J. L. Rich, of Cornell University, appears in the *Zeitschrift für Gletscherkunde* (Band vi., p. 225). The results agree mainly with those obtained by Mügge and MacConnell, and show that, as urged in 1869 by W. Mathews, those of Prof. Tyndall and Canon Moseley were inconclusive, through not taking sufficient account of the time-element in the problem. These recent experiments, which were both numerous and designed to test the various properties of ice, show that it welds readily at a temperature of 0° C.; that when a block of ice has been cut through by a wire and regelation has occurred, optical continuity is re-established, the new-forming crystals being controlled by those previously in existence, and that the welding, at temperatures well below the freezing point, to some extent resembles what has been observed in marble after being crushed.

The authors tentatively advance four propositions; the first, that the observed deformation is of the nature of plasticity, *i.e.* it is not initiated until a certain strain is reached, the plastic yield-point lying near the breaking point of the ice; the second, that the ease with which deformation may be produced varies with the direction in the crystal; the third, that the optical properties of a crystal are affected by such deformation, the effect being dependent upon the direction in the crystal in which the deformation takes place; and the fourth that granular ice, composed of interlocking crystals, is subject to deformation equally with a single ice-crystal. Pond-ice was mostly used in the experiments, but granular snow- and glacier-ice were also employed. The authors notice a suggestive fact in regard to the first, that in a cake 30 cm. thick, about 10 cm. at the top consisted of finely granular ice; the next 15 cm. of coarse prismatic crystals of ice, standing perpendicular to the water surface, and the remainder of finely granular ice with diversely oriented crystals.

THE WINDS IN THE FREE AIR.[1]

It was noticed in very early times that the wind in the upper air may be very different from what it is on the surface. Lucretius says: "See you not too that clouds from contrary winds pass in contrary directions; the upper in contrary way to the lower." Bacon advocated the use of kites in studying the winds; but it is only in quite recent years that any systematic attempt has been made to investigate the free air above the surface of the earth. Kites have been flown to a height of four miles, but it is a matter of some delicacy to get even so high as two miles.

The temperature of the free air may be recorded by a meteorograph attached to a small rubber balloon, which continues to ascend until the pressure of the gas inside bursts the envelope, and the instrument descends again to the surface. The beautiful instrument constructed by Mr. W. H. Dines, F.R.S., the pioneer of upper air research in this country, is so light that the torn fabric of the balloon is sufficient to act as a parachute and check the speed of descent.

[1] Discourse delivered at the Royal Institution on Friday, April 11, by Mr. Charles J. P. Cave.

The general result of the observations has been to show that the temperature of the air decreases with height up to a certain point, above which the temperature distribution is nearly isothermal; however much higher the balloon may ascend, there is little further change of temperature. This upper layer, discovered by M. Teisserenc de Bort, whose recent death meteorologists of every country lament, is called the stratosphere; the lower part of the atmosphere is the part that is churned up by ascending and descending convection currents, and is called the troposphere. The height at which the stratosphere is reached, as well as the temperature of the layer, varies from day to day and from place to place. In these latitudes it is met with at heights varying from about 8 to 14 km., with temperatures varying from −40° to −80° C.

It is not, however, with temperatures that I am chiefly concerned to-night, but with the wind currents in the different layers of the atmosphere. If one of the balloons carrying instruments, or a smaller pilot-balloon, is observed with a theodolite, its position from minute to minute can be determined, and from its trajectory, or its path, as it ascends, the winds that it encounters can be calculated.

The theodolite used is constructed specially for the purpose; a prism in the telescope reflects the light at right angles, so that the observer is always looking in a horizontal direction, even if the balloon is overhead. It is important that the observer should be in as comfortable a position as possible, for an ascent sometimes lasts more than an hour and a half, during which time the observer can only take his eye from the telescope for a few seconds at a time, otherwise he may lose sight of the balloon and be unable to find it again.

The balloon having been started from one end of the base, observations are taken from both ends at exactly the same times, usually every minute. From the positions of the balloon at each successive minute, which are plotted on a diagram, the run of the balloon during the minute can be measured, and hence the wind velocity during that minute can be obtained. After the wind velocities have been measured off, and the wind directions obtained from the directions of the lines on the diagram, another diagram is constructed showing the relation of the wind velocity and direction to the height.

It is not necessary, however, to have two observers if the rate of ascent of the balloon is known; in such a case, the complete path of the balloon can be calculated from the observations of one theodolite. It is not, however, possible to know the rate of ascent with complete accuracy, as up and down currents in the air will affect the normal rate. In practice, especially in clear weather, the method is fairly satisfactory. The method of one theodolite requires less preparation, and the subsequent calculations of the path of the balloon are less laborious, than in the case of observations taken with two theodolites from opposite ends of a base line.

The best time for observations is towards sunset, so that the balloon reaches its greatest height after the sun has set on the surface of the earth; at such times the balloon, still illuminated by the sun, shines like a planet, and on one occasion I should have found it impossible to tell which was the balloon and which was Venus, except for the movement of the balloon. The distances at which balloons may be seen through the telescope of the theodolite are remarkable. A striking instance was when the flash of the sun on the small meteorograph was seen, not once, but repeatedly, when the balloon was about nine miles above the sea and at a horizontal distance of about thirty miles.

In considering the structure of the atmosphere, as it has been revealed by the observations I have carried out, principally at Ditcham on the South Downs, we may divide the subject into two parts: first, the wind structure in the lowest kilometre, and secondly, the general wind distribution up to the greatest heights reached by the balloons.

It is a matter of common observation that the wind increases above the surface, and in these days of aërial navigation it is important to know the law of this increase. It seems that at Ditcham, the increase in velocity is at first linear or nearly so, and that the line representing the linear increase passes through zero velocity at sea-level. That is to say, if we plot the wind velocity at the surface and draw through it a line from zero velocity at sea-level, the wind velocities at other heights, up to half a kilometre to one kilometre, will lie very nearly on this line; this approximately linear increase has been found to agree with observations at several land stations, but over the sea other conditions probably prevail.

But there are occasions when this state of things does not apply at all; this is often the case in light breezes, and at times when the surface wind is very shallow, giving place to an entirely different wind *régime* in the first kilometre of height. At such times it often happens that the wind velocity is greatest a very little way above the surface. The fact that there are two separate conditions emphasises the danger of taking means. By taking the mean value of a number of separate observations we might get as a result that the wind neither increased nor decreased in the first kilometre of height, which in reality is only true on very rare occasions. As has been truly said, "La méthode des moyennes c'est le seul moyen de ne jamais connaître le vrai!"

Another question of great importance to aviators is the effect of hills upon the winds blowing over them. The balloons used in my investigations ascend at the rate of 500 ft. per minute, and in a few minutes are carried beyond the reach of ground eddies; in some cases, however, I have found that a balloon rose with more than its normal velocity when passing over hills if a strong wind was blowing, and the effect is visible sometimes even when the balloon is more than a kilometre above the surface; on other occasions very little effect has been observed. More light is being thrown on this question by the observations of Mr. J. S. Dines on slowly ascending balloons.

The lower layers of the atmosphere up to one or two kilometres are the most important to aviators. To meteorologists the higher layers offer problems of greater interest. In considering the winds in the free air it is convenient to have some datum to which to refer them. The observed surface wind is not convenient for this purpose, being too much affected by local conditions near the ground. A better datum is what is known as the gradient wind. Under the influence of the barometric gradient the air is being pressed towards the areas of low pressure, but the wind is actually blowing more or less along the isobars at right angles to the force. In much the same way, water in a basin, when allowed to escape through a hole in the centre, and when given a slight movement of rotation, moves round the basin at right angles to the forces which are pressing it towards the centre. In the case of the atmosphere the turning movement is given by the rotation of the earth under the moving air. For any pressure condition to be maintained the air must be moving with a certain definite velocity, depending on the shape of the isobars and the steepness of the barometric gradient. This rate can be calculated for the conditions obtaining at the time, and the wind so calculated is called the gradient wind. It has been found that there is a fairly good agreement between the wind so calculated and the observed wind at a height of ½ km. or so, but owing to friction the surface wind is usually of a smaller velocity, and directed more towards the low pressure.

In order to show in a clear manner the changes of wind at different levels, I have prepared some models which give a better mental picture of the conditions than a diagram. The atmosphere is supposed to be divided up into layers each 1 km. thick and the average wind in each layer is represented by a coloured card; the length of the card represents the velocity of the wind, 1 cm. representing 1 metre per second, 1 metre per second being about 2¼ miles per hour; the direction of the card shows the direction of the wind, the arrow flying with the wind. The red cards represent winds that may be supposed to bring air from an equatorial direction, that is winds from east-south-east through south to west-north-west, the blue cards winds that may be supposed to bring air from a polar direction.

For convenience I have divided the wind structures into five types; they are perhaps rather artificial, as I shall show later, but it is convenient to make some sort of classification, even when further knowledge must change it. In the first three types of wind structure, the wind increases above the surface and equals the gradient velocity at a height of ½ km. or so; above this in the first class the wind remains more or less equal to the gradient velocity, up to a height of 7 or 8 km.; in the second class the wind in the upper air greatly exceeds the gradient wind, and in the third class it falls off again to a lesser value; but in all three classes the direction remains much the same as that of the gradient wind.

The first type may be called the solid current; it does not seem to be associated with any particular type of isobars, but in a preponderance of cases the wind is easterly, and the remaining cases are nearly all westerly; it is rare to find the solid current with winds from the north, or from the south.

In rare cases there is scarcely any wind up to the greatest heights reached, and the little wind there is often blows from varying directions in different layers; this type, which may be looked on as a subclass of the first type, sometimes occurs in still anticyclonic conditions in summer.

In the second class the gradient wind, after being reached at a height of about ½ km., is greatly exceeded in the upper air; in some cases the wind at 2 or 3 km. is double the gradient value, or even more. This type is likely to occur when there is a low pressure to the north of the station and when there is a strong temperature gradient, such that the low temperatures correspond to the low pressures, and *vice versâ*; such conditions should theoretically cause an increase in wind velocity in the upper air, but it is not possible to calculate what the effect should be without knowing the temperatures, not only on the surface, but in the upper air over the region in question. One may, however, calculate what effect surface temperatures would have on the isobars at, say, 3 km., assuming that the vertical temperature gradient is the same at every point; a map constructed to show the isobars which have been thus calculated must be looked on as a rough approximation only to the real conditions. A map of the isobars at 3 km. for May 11, 1907, shows how much steeper was the gradient on this day in the upper air than it was on the surface, a fact which quite accounts for the rapid increase in wind velocity from 2 metres per second at the surface to 19 metres per second at 3 km.

Winds belonging to this class may come from any point of the compass.

The third class comprises those cases in which the wind, after reaching the gradient velocity in the first ½ km. or so, falls off more or less rapidly in the upper air. This class is almost entirely associated with easterly winds on the surface, when there is high pressure to the north and low pressure to the south. An east wind is usually, though not always, a shallow one; a south-west gale increases in the upper air, but when an easterly gale is blowing, causing such high seas and such dangers to shipping, it is curious to reflect that such a short distance up we should meet with light breezes, or even a complete calm.

We now come to the class of reversals when the wind in the upper air is very different in direction from that near the surface, and when it often bears no relation to the surface pressure distribution. In a typical case, after an initial increase for a short distance above the surface, we find the wind gradually decreasing as we ascend, until a layer is met with in which there is a complete calm; above this we find an entirely different wind, which usually increases as we go higher, as in the case of winds in the second class. It looks at first sight as though there were a discontinuity in the atmosphere, but I hope to show later that this is more apparent than real. A typical example of a reversal occurred on November 6, 1908, when the surface wind was easterly with a velocity of 17 metres a second, just below 1 km.; above this it fell off to a complete calm at 3 km.; at 4 km. there was a light north-west wind, which increased to a wind of 15 metres per second at 10 km. The weather map for this day is remarkable: over this country there is no sign on the surface of the westerly wind above, but it appears that in Germany, where the pressure was highest, the westerly wind must have been descending and must have divided into two currents, one flowing on as a westerly wind over eastern Europe, the other flowing back as the easterly wind recorded in this country.

There are other cases of reversal which are not so simple as the one described above. In many cases this type is associated with small depressions, or with small areas of high pressure which seem to be relatively shallow. The surface winds are related to these shallow systems, while the upper winds are controlled by larger areas of high and low pressure, shown on the weather maps at places lying farther from the point of observation.

On September 30, 1908, for instance, a southerly surface wind, after remarkable backing, gave place to a calm at 3 km.; above the calm another southerly wind is met with; in this case the surface wind is probably related to the high-pressure system over Germany; the upper wind to the depression approaching from the Atlantic. There was another somewhat similar case on November 16, 1908, though with winds from a different direction; the northerly surface wind backed, and a calm was met with; above this, very unexpectedly, came a thin stream of southerly wind, above which again was a north wind, increasing in velocity with height. In this case the lowest wind was part of the circulation of an anticyclone which was approaching these islands from the Atlantic; the intermediate southerly wind was perhaps the last remaining effect of the anticyclone over the Continent, while the upper wind was the outflow from above a depression near Iceland, a wind which belongs to another class to be noticed later.

In cases of reversal we find that the warm wind flows over the top of the one that comes from a colder region; there must somewhere be a line where the warm current is rising, where it must be cooled dynamically, and where its moisture may condense into cloud or rain. It is interesting to note that in most cases rain occurs somewhere in the region of the reversal, and in summer thunderstorms are frequent. Thunderclouds may often be seen to be in a wind coming from a contrary direction to the wind on the surface, and it seems possible that for anything like a sustained thunderstorm something in the nature of a reversal must exist; it is difficult to see how a difference of potential, sufficient to produce lightning, can be kept up unless winds from different directions are bringing masses of air at different potentials near to one another.

It has been noticed in Hampshire that when the sound of gun-firing in the Channel is distinct, it is, in summer, a sign of thunder; an explanation may be hazarded; if there is a reversal so that the upper wind is coming from the south, the sound waves travelling from this point with a slight upward tendency will be refracted on entering the upper current, and thus, instead of being dissipated in the upper air, may again reach the surface at a considerable distance from their point of origin. Such conditions of wind are those productive of thunderstorms. This may also possibly account for the superstition that gun-firing produces rain; the sound of guns is only carried to great distances under the conditions I have mentioned, which are precisely the conditions favourable for heavy rains.

A north-east wind with rain lasting many hours is a common and a very unpleasant type of weather; it is not obvious where the moisture comes from with such a wind, for the air from the dry regions of the Continent could scarcely become saturated in its short passage over the North Sea. I believe the moisture comes from the Atlantic in a south-westerly wind in the upper air. Balloons cannot be followed for any length of time in such weather, but I have sometimes observed that the north-easterly wind slackens considerably below the cloud level, and sometimes, when breaks in the clouds have enabled balloons to be followed a little farther, there have been unmistakable signs of reversal. A careful watch for upper clouds, seen through rifts in the lower cloud sheet, will often indicate an upper southerly wind. So sure do I feel of these facts that, though living only twelve miles from the Channel, I never hesitate to send up an instrument-carrying balloon in rainy weather with a north-easterly wind, feeling certain that, though the balloons may go towards the sea at first, they will ultimately return and fall on dry land. My confidence is usually justified by the balloons coming to earth in the Midlands or eastern counties.

The last type of wind structure to be considered is the outflow that seems to take place from the upper layers over a low-pressure system, causing west to north winds in the upper air on the east and south sides of the depression. Depressions out in the Atlantic, which cause south-west winds on the surface, give rise to west or north-west winds in the upper air over England; even cyclones so far off as Iceland produce such winds, and as they pass along the Arctic circle, between Iceland and Norway, they show their presence by an upper northerly wind over this country. As the upper wind is often quite different from that on the surface, reversals are frequent in this class, and are associated as usual with rains, and with thunderstorms in the summer. It may be that much of the rain that falls in the cyclonic depression is due to the rising of this outward flowing current over the very different surface current on the east and north-east sides of the depression.

In connection with the subject of reversals, I may mention the wave and ripple clouds that form such beautiful skyscapes. It used to be supposed that these were formed by winds from different directions flowing over one another and setting up waves; but the observations of pilot balloons have shown that between two currents from different directions there is either a layer of calm, or else the wind changes round gradually; two very different currents are not found in close juxtaposition: there is no abrupt transition between them.

To show the relation of the different types of wind structure to the surface pressures a model has been prepared; on the map are shown a depression and an area of high pressure, with arrows to show the wind directions; above the map is a sheet of glass to represent the first 5 km. of the atmosphere; on this are marked the winds one would expect to meet with at this level under the conditions of pressure supposed; above this sheet of glass is another representing the thickness of the atmosphere from the 5-km. level to the stratosphere. The model is on the scale of one-millionth, the vertical scale through the glass being approximately the same as the horizontal scale.

The churning up of the air resulting from the heating of the surface layers by contact with the earth heated daily by the sun, does not presumably reach into the stratosphere; there being no vertical movements, we should expect to find only such horizontal movements as are consistent with a suitable distribution of density. In the simplest cases the wind increases in velocity until a maximum is reached just below the stratosphere; above this the wind begins to diminish, and sometimes falls off in a very marked manner. There are occasions when all real wind seems to have ceased, and the balloon as it ascends through this curious region moves first in one direction and then in another, so that the relation of wind direction to height can only be represented on a diagram by a disconnected series of points.

What takes place still higher? Does this region of calm extend to the very confines of the atmosphere? We have practically no evidence to go on. In February, 1909, a meteor left a magnificent streak which was visible for two hours and a half; this trail, which was some forty miles above the surface of the earth, moved in a manner suggesting very high wind velocities, with sudden variations in the different layers through which it passed. But it is possible that the streak of a meteor may partake of the nature of an aurora, the luminous patches of which sometimes move in a remarkable way, and probably under forces other than those of the winds.

Having for purposes of classification divided the wind structure of the atmosphere into different classes, I must now attempt to put them together, and to show that some of the types that seem very different are in reality closely connected.

Following on inquiries made by Mr. W. H. Dines on the correlation between the surface pressure and various meteorological elements at a height of 9 km., it was suggested by Dr. W. N. Shaw, F.R.S., that the changes of pressure to which our changes of weather are due have their origin, not near the surface of the earth, as hitherto supposed by many meteorologists, but just below the level of the stratosphere, at a height of 9 km. or so above the surface. This view is in accordance with the observed facts of the wind distribution in the different layers of the atmosphere.

Supposing that on a certain day there is a pressure distribution just below the stratosphere, which at that level produces a westerly wind of a certain strength; this pressure distribution will be transmitted through all the lower layers of the atmosphere, and unless modified by other conditions will produce a west wind at the surface; the velocity of this wind will, however, be only about one-third of that at the 9-km. level owing to the greater density of the air near the surface. If, however, the air to the north at every height were at a lower temperature than the air at a corresponding height over the place of observation, there would be at all levels a tendency for easterly winds. This will have the effect of reducing the westerly wind as we descend through the atmosphere, and when the surface is reached the west wind will have a much lower value than it would have had were it only for the increased density of the air. If the wind at the 9-km. level is not very strong, or if the tendency to produce an easterly wind is strong, as would be the case if the air to the north were very cold, we may get a calm at the surface, or the calm may even be reached at some distance above the surface, in which case the tendency for easterly winds may actually produce such a wind, which will increase in velocity as we descend towards the surface under the layer of calm, and be strongest a little above the surface of the earth, at a point where surface friction begins to cause a diminution of velocity.

If, again, at the 9-km. level, there is a pressure distribution producing an easterly wind, cold air to the north will produce a tendency for an increase of easterly wind as we descend through the atmosphere; but the greater density of the air at the lower levels will produce a decrease of wind velocity from whatever direction the wind may be coming; the two tendencies may neutralise one another, in which case we get a solid current of east wind between the stratosphere and the ground level.

If there is no wind at the 9-km. level, cold air to the north will produce easterly winds in the lower levels, in which case we should find easterly winds increasing in velocity as the surface is approached.

These considerations give some idea of the mechanism by which the different types of vertical wind structure may be produced. The wind increasing in height, the solid current, the wind decreasing with height, are seen to fall into their places. The reversal, with an east wind near the surface and a west wind higher up, is only an extreme case of the slackening of the westerly wind near the surface; and the point of reversal, far from marking a point of discontinuity in the atmosphere, is seen to be merely the result of forces extending right through the lower part of the atmosphere, between the stratosphere and the earth.

If the winds are resolved into components at right angles to each other, that is north-south and west-east components, it is found that in most cases the west-east component decreases below the stratosphere and is a minimum near the surface, an east wind in this case being considered as a negative west wind. This is what should be the case if the ideas I have been considering are correct, for the air to the north is generally colder than the air over this country. In the case of the north-south component we find no such general rule, but this also is as it should be, for the air to the east and west may be either of the same temperature, or warmer, or colder than the air over the station; in other words, there is a normal north to south temperature gradient but not a normal west to east gradient, in our islands.

The supposed cases mentioned are, of course, simple types, and it can readily be understood how varying conditions of pressure and temperature may in similar ways produce varieties of vertical wind distribution. In considering the pressure distribution just below the stratosphere as the regulator of the winds and the weather in the lower part of the atmosphere, I fear I have nothing to add concerning the laws governing these pressure distributions; the idea is a new one, and has yet to be worked out in its details, and to stand the test of criticism and fuller investigation.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—An exhibition of 50*l.* a year tenable for two years is offered each year by the governing body of Emmanuel College to a research student commencing residence at Cambridge as a member of Emmanuel College in October. Applications, accompanied by two certificates of good character, should be sent to the master of Emmanuel not later than September 24.

The next combined examination for fifty-six entrance scholarships and a large number of exhibitions at Pembroke, Gonville and Caius, Jesus, Christ's, St. John's, and Emmanuel Colleges will be held on Tuesday, December 2, and following days, commencing at 9 a.m. on Tuesday, December 2. Mathematics, classics, natural sciences, and history will be the subjects of examination at all the above-mentioned colleges. Most of the colleges allow candidates who intend to study mechanical sciences to compete for scholarships and exhibitions by taking the papers set in mathematics or natural sciences. A candidate for a scholarship or exhibition at any of the six colleges must not be more than nineteen years of age on October 1, 1913. Forms of application for admission to the examination at the respective colleges may be obtained from the masters of the several colleges, from any of whom further information respecting the scholarships and exhibitions and other matters connected with the colleges may be obtained. The forms of application must be sent in on or before Saturday, November 22.

Mr. W. Dawson has been appointed reader in forestry in the University until September 30, 1917.

Oxford.—Additional buildings are about to be provided for research and teaching purposes in connection with the School of Forestry. The expense will be met partly out of the funds at the disposal of the Delegates for Forestry, and partly by a grant of 1000*l.* from the Development Fund controlled by the Treasury. The Council of the Surveyors' Institution has contributed 210*l.* towards the cost of a research laboratory on the diseases of trees.

Convocation has authorised the curators of the University Chest to receive the sum of 6000*l.* from the trustees of the University Endowment Fund, to be applied to the building and equipment of the new laboratory of engineering science, as soon as the allotted site shall have been legally secured to the University.

Dr. J. Argyll Campbell, junior assistant to Prof. Schäfer, in the University of Edinburgh, has been appointed professor of physiology in the University of Singapore.

The fortieth annual dinner of the old students of the Royal School of Mines will be held on Monday, June 9, at the Café Monico, Piccadilly Circus. Mr. Frank Merricks will be in the chair. Tickets may be obtained from the hon. secretary, Mr. T. A. Rickard, 820 Salisbury House, E.C.

The St. George's Gallery, New Bond Street, was the scene last week of an interesting exhibition of photographs of the Holy Land. These photographs were the work of Miss Sophie Nicholls, who travelled in Palestine in 1910–11 as a Frances Mary Buss travelling scholar. The scenic and panoramic views force upon the mind the aridity of the land, the apparent unchangeable character of the works of man in the towns or villages which are tucked, as it were, into crannies of the bleak hill slopes. A set of twelve of the most typical views has been compiled for the use of schools and colleges, and an explanatory book containing topographical maps showing the position of the camera and its range of view is in preparation. Particulars of these publications may be obtained from Messrs. J. A. Sinclair and Co., Ltd., 54 Haymarket, S.W.

The Board of Education has issued (Cd. 6795) its regulations for the training of teachers for elementary schools, to come into force on August 1 next. Substantial changes will then be made with regard to the curriculum and examinations of students who will follow the ordinary two years' course of the training college. The majority of students entering the training colleges now have had four years' education in a secondary school, whereas, when the old regulations for training colleges were drawn up, the general education of their students on entry was often very meagre. The changes are in the direction of diminishing the time devoted to general education by the training-college student and increasing that given to what are called "professional" subjects. More prominence, too, is to be given to practical work in teaching while at college. It has been found necessary to add to the equipment of the primary-school teacher a knowledge of hygiene and physical training, and both these subjects are classed as professional. Elementary science is rightly considered a subject of general education. Physics, chemistry, botany, rural science, and housecraft are called "additional," or "subjects which are not ordinarily needed by elementary-school teachers, but which may in certain cases be included in the training-college curriculum, either because they would be useful for teachers in schools of a special type, or because the student may desire to study them with a view to improving his own general education."

SOCIETIES AND ACADEMIES.

London.

Royal Society, May 8.—Sir Archibald Geikie, K.C.B., President, in the chair.—A. D. **Waller**: The various inclinations of the electrical axis of the human heart. This paper is in substance the direct continuation of a communication made to the society in 1889 (Phil. Trans., p. 169), in which it was shown (1) that the electrical effects accompanying the beat of the human heart can be demonstrated and studied by "leading off" from the mouth and from the extremities; and (2) that in consequence of the oblique situation of the heart in the thorax these "leads" are to be classified as favourable and unfavourable or strong and weak. Of the six possible leads from the four extremities, three are strong (transverse, axial, right lateral) and three are weak (inferior, equatorial, left lateral). Of the four possible leads from the mouth and one extremity, one is weak (right superior) and three are strong (left superior, right and left inferior). The electrical equator is an imaginary line of zero potential across the chest from left shoulder to right side. The electrical current axis is from right shoulder to left side, at right angles to the equator.—Surgeon-General Sir D. **Bruce**, Majors D. **Harvey** and A. E. **Hamerton**, and Lady **Bruce**: Trypanosome diseases of domestic animals in Nyasaland. III., *Trypanosoma pecorum*.—T. **Goodey**: The Encystation of *Colpoda cucullus* from its resting cysts and the nature and properties of the cyst membranes. The ectocyst ruptures and sets free the transparent endocyst. Both ectocyst and endocyst are composed of carbohydrate substances and are resistant to acids, weak alkalies, and many other reagents; failing to give any reaction with iodine in potassium iodide solution. The endocyst is composed of a new carbohydrate for which the name Cystose is proposed. During encystation the endocyst wall is digested by a powerful enzyme secreted by the enclosed organism, and by this means the latter is enabled to escape. The name Cystase is proposed for this enzyme.—C. **Shearer**, W. De **Morgan**, and H. M. **Fuchs**: The experimental hybridisation of Echinoids.

CAMBRIDGE.

Philosophical Society, April 28.—Dr. Shipley, president, in the chair.—A. H. **Evans**: Notes on additions to the flora of Cambridgeshire. The author stated that the combined efforts of the staff of the botany school, research students, and undergraduates had resulted in a large addition to the list of species given in his "Short Flora of Cambridgeshire" (Proc. Camb. Phil. Soc., xvi., part 3), while others of great interest had been discovered in new localities or rediscovered in their former stations. Of these perhaps the most interesting was the rare *Prunella laciniata*, but lately known to have occurred in England, while Mr. Moss had found with it what appeared to be undoubted hybrids with *P. vulgaris*.—H. Hamshaw **Thomas**: Some new and rare Jurassic plants from Yorkshire. In this communication Eretmophyllum, a new genus of plants allied to the Ginkgoales, is described. It is founded on leaves which possess the nervation, secretory tracts, and stomatal structure characteristic of Ginkgo leaves, while in their linear or oblanceolate shape they rather resemble those of Podozamites.—C. E. **Moss**: Some plants new to the British Isles. Rev. M. J. **Le Goc**: Observations on *Hirneola auricula-judae*, Berk. (Jew's ear). The author deals in his paper with the biology of *Hirneola auricula-judae*, Berk., "Jew's ear," with special reference to pure cultures in various media, to the fructifications obtained in these cultures, and to the action of the hyphæ on the tissues of the host.—Prof. A. C. **Dixon**: (1) The greatest value of a determinant the constituents of which are limited. (2) Expressions for the remainders when θ, θ', $\sin k\theta$, $\cos k\theta$ are expanded in ascending powers of θ.

May 5.—Prof. Nuttall in the chair.—Prof. **Nuttall**: Observations on ticks: (*a*) parthenogenesis, (*b*) variation due to nutrition. The occurrence of parthenogenesis in ticks was recently observed by Aragão, in Brazil, in a new species of Amblyomma (*A. agamum*), the males of which have not as yet been discovered. Three complete generations of this tick have been raised experimentally and thousands of females were brought to maturity in the absence of males. This constitutes the first record of parthenogenesis in ticks. Prof. Nuttall described how he had succeeded in obtaining a parthenogenetic offspring from *Rhipicephalus bursa*, a species (prevalent on sheep in countries bordering the Mediterranean) in which both sexes occur in fairly equal numbers upon the host. Larval ticks issued in limited numbers from the eggs laid by unfertilised females. Experiments were further recorded in which it was shown that the genus Rhipicephalus shows a considerable natural variation in size, and that imperfect feeding of the tick in its immature stages leads to the development of very small adults which, whilst fertile, are so different from the normal forms that they could readily be taken for other species.—E. **Hindle**: Exhibition of a Chinese flea-trap. The author exhibited an ingenious device for catching fleas commonly employed by the natives of Setchuen, western China. The apparatus consists of two pieces of bamboo one inside the other. The inner bamboo is coated with bird-lime to which any fleas adhere, whilst the outer one merely protects the sticky surface from coming into contact with bedclothes, &c., but is fenestrated in order to allow the free entrance of fleas.—Prof. A. D. **Imms**: Exhibition of living termites. The author exhibited tubes containing living examples of the termite *Archotermopsis wroughtoni*, Desn. The termites were obtained by him from the Kumam Himalayas, where they occur in dead trunks of the Chir pine (*Pinus longifolia*) at an altitude varying from about 4500 to 5800 ft.—K. R. **Lewin**: The division of *Holosticha scutellum*. The account of the behaviour of the micronuclei at division, given by A. Gruber ("Weitere Beobachtungen an vielkernigen Infusorien," *Ber. Naturf. Ges. zu Freiburg I.B.*, Bd. iii. (1887), pp. 57–70), is not confirmed. In the period between divisions, *H. scutellum* possesses only a small number of micronuclei of about the size of the meganuclear segments, with which they have been confused. There is therefore no necessity to assume that numerous micronuclear divisions occur at the fission of the infusorian.—H. B. **Fantham**: *Sarcocystis colii*, n. sp., a Sarcosporidian occurring in the red-faced African mouse bird, *Colius erythromelon*. The author gave an account of a new species of Sarcosporidia from a new avian host. The Sarcosporidian trophozoites (Miescher's tubes) were distributed throughout the skeletal musculature, being more concentrated in some areas than in others. They occurred also in the heart muscle, and were scattered in the pericardium, peritoneum, and in the intestinal mesentery.—J. T. **Saunders**: Note on the food of freshwater fish. The food of fish varies considerably, many different things being taken by one species as an article of diet. But a single fish does not eat indiscriminately everything that it comes across; on the contrary, its meals are found usually to consist of one kind of food only. A mixture of food is not often found in the stomach, and this will only occur when the fish is very hungry or under artificial conditions, such as obtain in a laboratory aquarium. The food also varies according to locality, even in ponds which are separated from each other by only a few yards; the food in the stomachs of fish taken from these ponds may be quite different. This variation affects equally all the individuals that live in the same pond; under the same conditions they will all feed on the same food.

PARIS.

Academy of Sciences, May 13.—M. F. Guyon in the chair.—Paul **Appell**: The polynomials $V_{m,n}$ of Hermite and their analogues connected with spherical functions in space of any number of dimensions.—Armand **Gautier** and P. **Clausmann**: Fluorine in the animal organism. Skeleton, cartilages, tendons. Determinations of amounts of fluorine in bones and teeth, cartilage, and tendons of mammals and fish. Fluorine has been found in all the organs examined, but the proportions vary widely. Fluorine is localised in a definite manner in the organism; it accompanies the phosphates of the alkaline earths and increases with them.—Paul **Sabatier** and M. **Murat**: The preparation of several di*cyclo*hexylbutanes. Description of the preparation and properties of five out of the nine possible isomeric di*cyclo*hexylbutanes.—L. de **Launay**: Some broken-up rocks of the Central Plateau (France).—M. de **Forcrand**: Trouton's law. The relation L/T = constant (about 22) is known not to hold in many cases, the value of L/T varying from 4·5 for helium to 0·27 for copper. Nernst has suggested $L/T = 9{\cdot}5 \log T - 0{\cdot}007\,T$. This gives a closer approximation to experiment, but is still unsatisfactory. The author further modifies this formula to

$$L/T = 10{\cdot}1 \log T - 1{\cdot}5 - 0{\cdot}009\,T + 0{\cdot}0000026\,T^2.$$

Between 250° and 900°, this gives a value for L/T approximating to 22, the original Trouton constant.—Ph. **Barbier** and R. **Locquin**: The methodical degradation of some monobasic and dibasic acids (see p. 303).—MM. **Fayet** and **Schaumasse**: The provisional orbit of the new comet 1913*a* (Schaumasse). The comet will be best seen about the beginning of June.—Gaston **Cotty**: The reduction of binary quadratic forms with integral coefficients in a real quadratic body.—E. **Landau**: Lambert's series.—Jules **Andrade**: Lateral independence of the balance spring in marine chronometers. Diminution of the variation from isochronism due to inertia.—A. **Cotton** and H. **Mouton**: The magnetic double refraction of liquids. The magnetic double refraction of solutions of nitrobenzene in carbon tetrachloride shows wide variation from an additive law; the specific double refraction of the nitrobenzene appears to be reduced by the addition of an inactive diluent.—R. **Fortrat**: The simplification of lines of the spectrum by the magnetic field. A study of the effect on the lines of a very strong magnetic field (40,000 Gauss). In the case of the green band of carbon the field reduced all the doublets to single lines, and the triplets were also reduced to single lines when the three lines were fairly close together. Similar effects were also noted in the blue band of the Swan spectrum, and the spectrum of the negative pole of nitrogen. The phenomenon appears to be general in band spectra.—M. de **Broglie** and F. A. **Lindemann**: The optical phenomena presented by the Röntgen rays meeting crystalline media. An examination of the various hypotheses proposed for explaining the production of fringes described in an earlier paper. The hypothesis that the fringes are caused by reflections on the cleavage planes of the crystal agrees best with the experimental results.—L. **Gay**: The calculation of the latent heats of evaporation. A modification of the Clapyron formula is proposed, partly based on Nernst's expression.—Louis **Hackspill**: The solid hydrogen phosphides. The alkaline phosphides of the type M_2P_5, described in a previous communication, give a solid hydrogen phosphide on treatment with dilute acetic acid, and this on analysis gives figures agreeing with the composition H_2P_5.—J. **Bougault**: Phenyl-α-oxycrotonic acid, its preparation and a new isomeride. A study of the best conditions of obtaining the acid from its amide; the hydrolysis of the latter is best carried out by heating with a solution of oxalic acid. An isomeride was obtained in the course of this work which differed from those previously known; it would appear to be the enolic form of benzoylpropionic acid.—Edouard **Bauer**: 1-Benzoyl-2-phenyl-Δ_1-*cyclo*pentene.—Maurice **Lugeon** and Mlle Elisabeth **Jérémine**: The presence of limestone bands in the Swiss part of the massif of the Aiguilles Rouges.—V. **Vermorel** and E. **Dantony**: Fungicidal pasty solutions possessing moistening power. It is important that the copper preparations used in viticulture should moisten the leaves. This effect can be secured by the addition of gelatine to solutions with acid reaction and casein to alkaline solutions.—Ch. **Brioux** and M. **Guerbet**: Sulphur in the soil: study of its oxidation. The oxidation of the sulphur in the soil is shown to be due to microbial action. The phenomenon is complicated, several bacteria appearing to take part in the oxidation.—J. M. **Lahy**: Organic adaptation in states of attention.—Raoul **Bayeux**: The comparative resistance of the dog and the rabbit to intravenous injections of carbonic acid. The ratio between the receptivity of the dog and the rabbit is the same for carbonic acid as for oxygen; in the two cases the volume of the former gas is five times greater than that of the latter.—P. **Chaussé**: The methods to be used for experimental tuberculosis by inhalation. Details of the methods used for the pulverisation of wet and dry virus.—Jacques **Pellegrin**: A new genus of the Centrarchideæ of the Gabon.—Charles **Lepierre**: The replacement of zinc by copper in the culture of *Aspergillus niger*. Copper, like cadmium, uranium, and beryllium, may replace zinc in Raulin's solution, and has the same effect in causing a rapid growth of the mould.—H. **Bierry** and Z. **Gruzewska**: The estimation of glycogen in the muscles.—Em. **Bourquelot**, H. **Hérissey**, and M. **Bridel**: The biochemical synthesis of the glucosides of alcohols (α-glucosides) by the aid of a ferment, α-glucosidase, contained in the yeast from low beer, air dried. α-Propylglucoside and α-allylglucoside.—L. **Cayeux**: The genesis of sedimentary iron minerals.—Pierre **Bonnet**: The structure of the chains between Lake Gœktchai and the Araxe.

BOOKS RECEIVED.

Atlas Notes. By J. C. Chute. Pp. 82. (London: Oxford University Press.) 1*s*.

Dent's Practical Notebooks of Regional Geography. By Dr. H. Piggott and R. J. Finch. Book iii. Africa. (London: J. M. Dent and Sons, Ltd.) 6*d*. net.

The Fishes of the Stanford Expedition to Brazil. By Prof. E. C. Starks. Pp. 77+xv plates. (California: Stanford University.)

The Statesman's Year-Book, 1913. Edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein. Pp. xcvi+1452+x plates. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

The National Physical Laboratory. Report for the Year 1912. Pp. 123. (Teddington: W. F. Parrott.)

Report for 1912 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel. Edited by Prof. W. A. Herdman. Pp. 318+iii plates+v charts. (Liverpool: C. Tinling and Co., Ltd.)

Flowerless Plants: How and Where They Grow. By S. L. Bastin. Pp. xi+152+plates. (London: Cassell and Co., Ltd.) 6*s*. net.

Metamorphose der Muraenoiden. By Dr. B. Grassi. Pp. x+211+xv plates. (Jena: G. Fischer.) 50 marks.

Papers Set in the Mathematical Tripos, Part i., in the University of Cambridge, 1908–12. Pp. 70. (Cambridge University Press.) 2*s*. 6*d*. net.

A Text-Book of Thermodynamics (with Special Reference to Chemistry). By J. R. Partington. Pp. viii+544. (London: Constable and Co., Ltd.) 14*s*. net.

The Laws of Thermodynamics. By W. H. Macaulay. Pp. viii+71. (Cambridge University Press.) 3*s*. net.

The Principles of Projective Geometry applied to the Straight Line and Conic. By J. L. S. Hatton. Pp. x+366. (Cambridge University Press.) 10*s*. 6*d*. net.

Insects: Their Life-Histories and Habits. By H. Bastin. Pp. xii+349+xlvi plates. (London and Edinburgh: T. C. and E. C. Jack.) 7*s*. 6*d*. net.

Mathematical Physics. Vol. i., Electricity and Magnetism. By C. W. C. Barlow. Pp. vii+312. (London: W. B. Clive.) 4*s*. 6*d*.

An Index to the Scientific Contents of the Journal and Proceedings of the Academy of Natural Sciences of Philadelphia. Pp. xiv+1419. (Philadelphia: Academy of Natural Sciences.) 3.50 dollars.

The Social Guide, 1913. Edited by Mrs. H. Adams and E. A. Browne. Pp. xxxv+7+264. (London: A. and C. Black.) 2s. 6d. net.

School and Home Gardens. By W. H. D. Meier. Pp. v+319. (Boston, Mass., and London: Ginn and Co.) 4s.

An Introduction to the Mathematical Theory of Heat Conduction. With Engineering and Geological Applications. By Prof. L. R. Ingersoll and O. J. Zobel. Pp. vi+171. (Boston, Mass., and London: Ginn and Co.) 7s. 6d.

Agronomy: a Course in Practical Gardening for High Schools. By W. N. Chute. Pp. xvi+296. (Boston, Mass., and London: Ginn and Co.) 4s. 6d.

A Course in General Chemistry. By Profs. W. McPherson and W. E. Henderson. Pp. viii+556. (Boston, Mass., and London: Ginn and Co.) 10s. 6d.

Lehrbuch der sphärischen Astronomie. By Dr. L. de Ball. Pp. xv+387. (Leipzig: W. Engelmann.) 20 marks.

Ueber das Wesen der Mathematik. By Dr. A. Voss. Zweite Auflage. Pp. iii+123. (Leipzig and Berlin: B. G. Teubner.) 4 marks.

The Riddle of the Universe. By E. Haeckel. Translated by J. McCabe. Pp. xxviii+324. (London: Watts and Co.) 9d. net.

L'Homme Fossile de la Chapelle-aux-Saints. By Prof. M. Boule. Pp. 278+xvi plates. (Paris: Masson et Cie.) 50 francs.

Journal of the British Fire Prevention Committee. No. x. The Record of the Special Commission formed by the British Fire Prevention Committee to Visit Russia, being a Diary and Notes compiled by E. O. Sachs. (London: British Fire Prevention Committee.) 10s. 6d.

Handbuch der Morphologie der wirbellosen Tiere. Edited by A. Lang. Zweite Bezw. Dritte Auflage. Band I. Lief. 1. (Jena: G. Fischer.) 5 marks.

Black's Sentinel Readers. By Prof. E. E. Speight. Book iii. Pp. viii+184. (London: A. and C. Black.) 1s. 4d.

DIARY OF SOCIETIES.

THURSDAY, MAY 22.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: Rays of Positive Electricity: Sir J. J. Thomson.

ROYAL INSTITUTION, at 3.—Recent Chemical Advances. I. Molecular Architecture: Prof. W. J. Pope.

CONCRETE INSTITUTE, at 4.30.—Annual General Meeting.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Determination of Water in Coal: P. L. Teed.—Grading Analyses by Elutriation: H. Stadler.—Notes on Sinking Operations at the Spring Mines, Transvaal: B. D. Bushell.—An Early Example of Blast-roasting: H. Vassiliadi.

FRIDAY, MAY 23.

ROYAL INSTITUTION, at 9.—The Secret of the Permanent Magnet: Prof. S. P. Thompson.

SATURDAY, MAY 24.

ROYAL INSTITUTION, at 3.—Radio-activity. I. The α Rays and their Connection with the Transformations: Prof. E. Rutherford.

MONDAY, MAY 26.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary Meeting.

TUESDAY, MAY 27.

ROYAL INSTITUTION, at 3.—Recent Advances in the Production and Utilisation of Wheat in England: Prof. T. B. Wood.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Sub-Crag Flints: Sir Edwin Ray Lankester, K.C.B.

WEDNESDAY, MAY 28.

GEOLOGICAL SOCIETY, at 8.—The Age of the Suffolk Valleys, with Notes on the Buried Channels of Drift: P. G. H. Boswell.—The Internal Structure of Upper Silurian Rugose Corals, from the Grindrod Collection, Oxford Museum: D. E. Innes.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, MAY 29.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: *Acineta tuberosa*; a Study on the Action of Surface Tension in Determining the Distribution of Salts in Living Matter: Prof. A. B. Macallum.—Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. IV. The Mzimba Strain: Surg.-General Sir David Bruce, Major D. Harvey, Major A. E. Hamerton, and Lady Bruce.—Notes on *Plasma gondii*: Helen L. M. Pixell.—An Investigation by Pedigree Breeding into the Polymorphism of *Papilio polytes*. Linn.: J. C. F. Fryer.—The Action of Radium Rays upon the Cells of Jensen's Rat Sarcoma: Dr. S. Russ and Dr. Helen Chambers.

ROYAL INSTITUTION, at 3.—Recent Chemical Advances. II. Chemistry in Space: Prof. W. J. Pope.

ROYAL SOCIETY OF ARTS, at 4.30.—Indian Section.—Irrigation Works in India: Sir John Benton, K.C.I.E.

FRIDAY, MAY 30.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting. At 8.30.—Practical Application of Telephone Transmission Calculations: A. J. Aldridge.

PHYSICAL SOCIETY, at 5.—The Origin of New Stars: Prof. A. W. Bickerton.—Electro-thermal Phenomena at the Contract of Two Conductors with a Theory of a Class of Radio-telegraph Detectors: Dr. W. H. Eccles.—The Evaluation of Certain Combinations of the Ber, Bei, and Allied Functions: S. Butterworth.—The Extraordinary Ray Resulting from the Internal Reflection of an Extraordinary Ray at the Surface of an Uniaxal Crystal: J. Walker.

SATURDAY, MAY 31.

ROYAL INSTITUTION, at 3.—Radioactivity. II. The Origin of the Beta and Gamma Rays and the Connection between them: Prof. E. Rutherford.

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A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, MAY 29, 1913.

OLD HERBALS.

Herbals: their Origin and Evolution. A Chapter in the History of Botany, 1470–1670. By Dr. Agnes Arber. Pp. xviii + 253 + xxi plates. (Cambridge University Press, 1912.) Price 10*s*. 6*d*. net.

IN this age of literary activity it is difficult to find a sphere of knowledge that has not been hitherto exploited by the makers of books. It is therefore a refreshing experience to find that the work before us is the first attempt to present to the public a popular survey of this fascinating old literature of herbals. The active life-period of this literature extends over a course of two hundred years, beginning in the latter part of the fifteenth and ending during the second half of the seventeenth century.

These curious old books treat of the medicinal virtues of plants and herbs, and were written chiefly by physicians for their own convenience and the use of the public at a time when botany was still a branch of medicine. But, in addition to the medical, they possess an artistic interest, being illustrated from the earliest times with woodcut figures of plants. This is exemplified in the profuse collection of choice and beautiful illustrations in Mrs. Arber's work.

The mediæval encyclopædia of Bartholomæus Anglicus has a section dealing with herbs and trees and their medicinal properties, and although this is perhaps the first printed book containing information of a strictly botanical nature, the earliest work to which the term "herbal" is generally applied is the Latin Herbarium of Apuleius Platonicus, first printed at Rome about 1484 by the physician to Pope Sixtus IV. This little book, based on classical writings, and illustrated with figures coming down from late Roman art, was, in its manuscript form, the chief text-book of medicine of our Anglo-Saxon forefathers.

But we must turn to Germany for the *doyens* amongst printed herbals. These are the Latin "Herbarius" (1484), the German "Herbarius" (1485), and the "Hortus Sanitatis" (1491), all three representing a tradition of great antiquity and printed at Mainz. It is also to the German "fathers of botany," Brunfels and Fuchs, that we owe the handsome herbals which, for the beauty and faithfulness of their illustrations, remain not only unsurpassed by any other herbal, but perhaps unequalled. In the Netherlands, Italy, Switzerland, and France the herbal attained great popularity, and for an account of its origin and growth in these countries Mrs. Arber's work must be read.

The first work printed in our own country, dealing exclusively with the medicinal virtues of herbs, was a small quarto volume without illustrations published anonymously by Richard Banckes in 1525. During the next four decades this book was in great demand, no fewer than about fourteen editions appearing, some with the names of Macer, Linacre, and Askham on the title-pages, and others attributed erroneously to the physician Walter Cary and to the printer William Copland. But a year after the appearance of Banckes's book there appeared the fine folio, with woodcut illustrations, called the "Grete Herball." This was a translation of the French work "Le Grant Herbier." Nevertheless, it may be looked upon as the *doyen* of the English herbals, and no lover of books would wish to dispute this claim after reading the delightful old phraseology in the quaint black letter fount of our early printers. The herbals of the great English botanists, William Turner, John Gerard, Henry Lyte, and John Parkinson, are all described in the work before us.

We wish we had space enough to deal adequately with other interesting parts of Mrs. Arber's work. The chapter on the evolution of botanical illustration, and the well-chosen illustrations numbering upwards of one hundred and twenty, show clearly the important position this old herbal literature occupies in the history of wood-engraving. But our concluding remarks must be confined to the chapter on signatures and astrological botany. Absurd and preposterous as these doctrines are, they nevertheless make delightful reading. According to the former, many medicinal plants were stamped, as it were, with some indication of their uses. In this extraordinary superstition of the mystics, described by Dr. Paris as the most absurd hypothesis that ever disgraced the annals of medicine, the best botanists of the period had little belief; and in astrological botany they perhaps had less. Nevertheless, as Mrs. Arber rightly explains,

> "a number of books dealing with such topics appeared during the period we have considered, but their writers form a class apart, and must not be confused with the herbalists proper, whose attitude was, on the whole, marked by a healthy scepticism, which was in advance of their time. It would, naturally, be far from true to say that they were all quite free from superstition, but, considering the intellectual atmosphere of the period, their enlightenment was quite remarkable."

The few inconsistencies we have noticed are chiefly bibliographical in their nature, and do not detract from the merits of the book. We confidently recommend it to all lovers of antiquarian lore.

THE BELIEF IN IMMORTALITY.

The Belief in Immortality and the Worship of the Dead. By Prof. J. G. Frazer. Vol. i.: The Belief among the Aborigines of Australia, the Torres Straits Islands, New Guinea, and Melanesia. Pp. xxi+495. (London: Macmillan and Co., Ltd., 1913.) Price 10s. net.

THE publication of Prof. Frazer's Gifford lectures has been awaited with interest by students of anthropology and religion. Their subject was one of the first to occupy the author's attention; his paper on primitive burial customs placed the study of the belief in immortality and the worship of the dead in a new light. He has now given us the first instalment of a comprehensive survey of the whole institution. Psychical and ceremonial though it is, the doctrine and cult form an institution as deserving of the name as political government. The belief in some degree of immortality has been practically universal, and is still a "last infirmity of noble mind"; some form of "worship," fear of the ghost or actual veneration of the deified ancestor, has accompanied the belief in the case of the majority of peoples. The author acutely points out, for the consideration of "historians and economists, as well as of moralists and theologians," that the direct consequences of this moral institution have been grave and far-reaching, such as no mere sentiment could have produced, not only in primitive but in civilised history. It has, he says,

"not merely coloured the outlook of the individual upon the world; it has deeply affected the social and political relations of humanity in all ages; for the religious wars and persecutions, which distracted and devastated Europe for ages, were only the civilised equivalents of the battles and murders which the fear of ghosts has instigated amongst almost all races of savages of whom we possess a record. . . . And when we consider further the gratuitous and wasteful destruction of property, as well as of life, which is involved in sacrifices to the dead, we must admit that with all its advantages the belief in immortality has entailed heavy economical losses upon the races—and they are practically all the races of the world—who have indulged in this expensive luxury."

The treatment of the subject is, so far, merely descriptive; it is not even comparative. But the analysis of belief and practice among the aborigines of Australia, the Torres Straits, New Guinea, and Melanesia, which occupies nearly 400 pages of this volume, is a masterly performance. The intention of the author is to pursue this method from the lower to the higher planes of culture. The savage conception of death as unnatural, and due, first to sorcery, and secondly to the operation of ghosts or spirits, is further studied, and shown in its development towards a recognition of disease and accident as causes. The interesting view of Weismann and Wallace that death in higher organisms may actually be an acquired adaptation is cited in comparison.

There is an extraordinary likeness between the varieties of belief and ceremony, which never degenerates into mechanical sameness. In one case their connection with tabu results in a very sensitive regard for the rights of property; in another, the fear of sorcery leads to a punctilious system of sanitation and scavenging; in several cases the dramatic art finds its beginnings in the ghost-dance and similar propitiatory ceremonial. Incidentally, the author quotes interesting varieties of the belief in the soul, which he assumes, though he does not go further than Tylor's dream-theory, to be the cause of the general belief in survival after death. It is to be hoped that in future volumes the author will treat the cause with the same fullness as he has treated the effect.

A. E. Crawley.

RECENT PSYCHOLOGY AND LOGIC.

(1) *Elements of Physiological Psychology.* A Treatise of the Activities and Nature of the Mind from the Physical and Experimental Points of View. By Prof. G. T. Ladd and Prof. R. S. Woodworth. (Thoroughly revised and re-written.) Pp. xix+704. (New York: Charles Scribner's Sons, 1911.) Price 4 dollars net.

(2) *Formal Logic: a Scientific and Social Problem.* By Dr. F. C. S. Schiller. Pp. xviii+423. (London: Macmillan and Co., Ltd., 1912.) Price 10s. net.

(3) *Der Mechanismus des menschlichen Denkens.* By Erich Ruckhaber. (Humboldt-Bibliothek, Heft 2.) Pp. 126. (Brackwede i. W.: Dr. W. Breitenbach, 1911.) Price 2 marks.

(4) *Religion and Modern Psychology.* By J. Arthur Hill. Pp. vii+200. (London: Wm. Rider and Son, Ltd., 1911.)

(5) *Is the Mind a Coherer?* By L. G. Sarjant. Pp. 304. (London: George Allen and Co., Ltd., 1912.) Price 6s. net.

THE first two books of those mentioned above are by far the most important of the group. The new, largely re-written edition of (1) Ladd's "Physiological Psychology" will be welcomed by students of psychology. Nearly twenty-five years have passed since the first edition of the book, a period within which the then new branch of experimental psychology has forced its way to the front. Very considerable additions have been made to this book in the section on the physiology of the nervous system. It may be questioned whether such a full study of physiological processes is not better obtained, even by the student of psychology, directly from standard works on physiology. It has the advantage, however, of forming a selected introduction to the later parts of the work, in which the psychology of the senses obtains the fullest treatment.

In his book (2) on formal logic, Dr. Schiller attacks the fundamental assumption of that science, viz., that one *can* consider the purely formal aspect of truth alone. The book is written in a style quite characteristic of the most prominent upholder of Pragmatism in this country. We have not space to give the book the full discussion which it deserves. We may observe, however, that the fact that all the problems of logic shade off into those of metaphysics or psychology, even if true, does not imply that it cannot do useful and essential work in its own sphere.

(3) In "Der Mechanismus des menschlichen Denkens" the author has sought to present in handier form some of his ideas upon the mechanical interpretation of thought expounded in his larger work, "Des Daseins und Denkens Mechanik und Metamechanik." In the first section he discusses the "feeling of contradiction" as a fundamental factor of all thought. This is followed by a critical consideration of the association theory and the logical, psychological, and physiological objections to it. Memory and thought are dealt with in a third section, in which the unity of brain-function in memory is emphasised.

(4) "Religion and Modern Psychology" would have more aptly been called "Mysticism and Psychical Research." A discussion of mysticism occupies a large portion of the book, and psychical research is of central importance to the author's position, which is that little else can afford satisfactory reasons for belief in a future life. The book is written in a readable style, and contains very numerous quotations—for those who are fond of them. Theism is dismissed in a couple of pages, though the author "distrusts those who arrive at a conclusion too speedily." "Metaphysics," he says on p. 35, "is obsolete in the ontological sense," yet in the concluding chapter he describes, with qualified approval, a crude metaphysic which gives a sort of world soul to each of the heavenly bodies.

(5) The last-named book is a metaphysical essay which will probably prove highly amusing to the trained philosopher, but highly confusing to the novice. The book begins with the question, "Do you ever go out of your mind, reader?" and we must confess that in reading the book we have several times felt that we did. We regret that space forbids us to quote one of the many passages which rival anything we have met for obscurity of thought and confusion of language.

ANATOMY, NORMAL AND MORBID.

(1) *The Essentials of Morbid Histology.* For the use of students. By Prof. A. S. Grünbaum. Pp. xvi + 219. (London: Longmans, Green and Co., 1912.) Price 7*s.* 6*d.* net.

(2) *Die Muskeln des Stammes.* By Prof. P. Eisler. (Handbuch der Anatomie des Menschen. Herausgegeben von Prof. K. von Bardeleben. Zweiter Band. Zweite Abt. Erster Teil.) Pp. xii + 705. (Jena: Gustav Fischer, 1912.) Price 38 marks; subscription price, 35 marks.

(3) *Neue Lehre vom zentralen Nervensystem.* By Dr. Em. Rádl. Pp. vii + 496. (Leipzig: W. Engelmann, 1912.) Price 12 marks.

(1) THE aim of Prof. Grünbaum's book is to provide the student of pathology with a manual that will serve the same purpose as Prof. Schäfer's well-known book on histology does for the student of normal anatomy. The author has succeeded in compressing into a small compass a great deal of information (and an excellent series of well-chosen figures) without any sacrifice of lucidity of treatment. To select from the enormous amount of material now available the subject-matter for a small manual upon morbid histology for students is a task of great difficulty, and perhaps no two pathologists would make precisely the same choice. It would be easy to criticise any such selection as this book contains; but, on the whole, Prof. Grünbaum has succeeded in producing a work that will be welcomed by all medical students, and we think by most teachers of pathology and medicine. The publishers are to be heartily congratulated on the excellence of their work, and especially on the clearness of the illustrations.

(2) Everyone who has had occasion to refer to that great anatomical library known as Bardeleben's "Handbuch," of which Prof. Eisler's volume constitutes the twenty-first "Lieferung," must have been impressed with the extraordinary inequality of the different volumes, both as regards the material and the manner in which the information is presented. This large treatise on the muscles of the trunk is one of the best volumes that have yet appeared. Needless to say, a book of 705 pages dealing solely with the trunk muscles of man is a storehouse of detailed information; but its great merit is that most of it is the result of the author's original observations. He freely refers to the work of other investigators, and gives copious illustrative facts from comparative anatomy, but the reader is made to feel that he is getting first-hand information throughout. The illustrations are excellent, both artistically and

anatomically, for they have that kind of accuracy which no artist who is not the investigator and author ever can portray.

As a work of reference and a storehouse of accurate information, Prof. Eisler's monograph will be invaluable.

(3) In the notes upon the other two volumes we have been dealing with facts, normal and pathological; but in Dr. Rádl's excursion into transcendental philosophy we are invited into the realms of ultra-Bergsonian casuistry, which is certainly not the normal environment of the biologist. The major part of his book is devoted to a discussion of the comparative anatomy of the visual organs and related nervous structures, chiefly of invertebrate animals; and the author uses these facts, or rather his speculative interpretation of them, as the ammunition for an attack upon the usual methods of biological argument, and especially upon theories of phylogenesis. It is easy to see why he chose the visual organs for this purpose: the data relating to the other sensory mechanisms, if employed as he uses his materials, would all have pointed in the direction opposite to that desired by Dr. Rádl. But the retina grows out from the central nervous system: therefore it is not formed by the influence of environment; it is the material expression of the "neue Lehre" that the mind makes its own instruments! This is the kind of argument, if such speculations can be called argument, that Dr. Rádl indulges in. It seems to the reviewer that Dr. Rádl has not sufficiently acknowledged his indebtedness to Bergson; but, on the other hand, his statement lacks even the superficial plausibility of Bergson's writings.

OUR BOOKSHELF.

Tracks of the Sun and Stars, A.D. 1900 *to* A.D. 37900. Photographs from Stereoscopic Perspective Drawings made at Tenby, A.D. 1912–13. By Thomas Edward Heath. Pp. 17 + photographs. (London: W. Wesley and Son; Manchester: Flatters and Garnett, Ltd., n.d.) Price 5*s*. net.

It has probably occurred to many who are interested in the study of stellar motions that it would be instructive to have a model of those star-tracks which are known, so that the phenomena in the three-dimensional aspect might be more easily grasped. By means of Mr. Heath's stereoscopic drawings it is now possible to have such a model before our eyes, and to see in a vivid manner the complex system of motions of a portion of the stellar universe. We have been delighted with the clearness with which the varying inclinations and directions of the interlacing movements are shown. Perhaps the most striking impression is the very considerable change of relative position which takes place in the selected interval of 36,000 years—a period by no means long from the astronomical point of view. The great range of difference in the speeds of the stars is also brought out prominently.

In order to ascertain the complete motion of a star, the proper motion, radial motion, and parallax must be known, the parallax being generally much the most uncertain of these quantities. In some cases where the value is small, Mr. Heath's tracks are rather hypothetical; but recent researches have increased considerably the number of trustworthy parallaxes, and the data used for these drawings appear to be well selected on the whole. Two views are given, in one of which the observer is supposed to be removed 100 light-years, and in the other 200 light-years, from the present position of the sun. The letterpress contains useful instructions for the reader who wishes to make for himself other drawings of this character.

A. S. E.

Die europaeischen Schlangen. Kupferdrucktafeln nach Photographien der lebenden Tiere. By Dr. Fritz Steinheil. Erstes Heft. (Jena: Gustav Fischer, 1913.) Price 3 marks.

Although there is no lack of good figures of most of the snakes of Europe, yet these are mostly executed from preserved specimens. We therefore welcome the publication, of which the first fascicle has just appeared, undertaken by the enterprising firm of Gustav Fischer, in which Dr. Steinheil intends to represent, by means of photographs taken from living examples, the different species of snakes inhabiting Europe, as well as their principal varieties. The five copper-plates now issued could scarcely be surpassed.

The letterpress accompanying each plate is short, and deals merely with the geographical distribution and the habits in captivity; no information is given concerning the mode of reproduction, a subject of particular interest not only to the herpetologist, but also to the amateur who keeps snakes in the terrarium. No systematic order is followed, but a brief introduction explains the classification followed, which, as well as the nomenclature, is in accordance with the British Museum catalogue of snakes, also adopted in Schreiber's recently issued second edition of the "Herpetologia Europæa." In fact, as the author tells us in the preface, this work is intended to serve as an atlas to the "Herpetologia Europæa," and as such will prove of great service.

G. A. B.

Die Methoden der exakten, quantitativen Bestimmung der Alkaloide. By Prof. Anton Ritter von Korczynski. Pp. iv + 82. (Berlin: Gebrüder Borntraeger, 1913.) Price 3.50 marks.

This little work deals with the methods by which alkaloids may be accurately determined quantitatively, but not with the methods by which the total alkaloids may be extracted from crude drugs or their preparations, although an appendix of fifteen pages contains the details of the alkaloidal drug-assays of the German Pharmacopœia. One-third of the book is devoted to the determination of quinine; morphine and the opium alkaloids, and strychnine and brucine, occupy the next places of importance, whilst the remaining alkaloids are very briefly discussed. It is essentially a compilation, and, like all compilations, has a distinct value. In this case the value is somewhat adversely affected by the scanty treatment that some of the alkaloids have received. Thus the separation of emetine from cephaëline is simply mentioned, although Paul and Cownley showed long ago how it could be effected, and Farr and Wright have published a method for the accurate determination of colchicine, to which no reference is made; indeed, the results obtained by English workers in this field have been sadly neglected. The utility of the work would be much enhanced by a more thorough examination of the literature.

Manual of Wireless Telegraphy and Telephony. By A. F. Collins. Third edition. Pp. xv+300. (New York: John Wiley and Sons; London: Chapman and Hall, 1913.) Price 6*s*. 6*d*. net.

THIS edition differs from the first, which was reviewed in the issue of NATURE for February 14, 1907 (vol. lxxv., p. 366), in several respects. The improvements in apparatus, and the advances made in wireless telegraphy in other directions, have led Mr. Collins to extend his treatment of the apparatus of a commercial station, and to describe the transmitting and the receiving instruments in separate chapters. The suggestions to operators relating to the management of stations are more exhaustive, and other useful additions have been made.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Artificial Hiss.

CAN any of your readers tell me how to make an artificial hiss? I have heard something like one from steam blowing off at a safety-valve. There the pressure was very high, but in the mouth a hiss is made with a moderate pressure behind. The problem must have been faced by inventors of speaking machines, but I do not know with what success. The best that I have been able to do myself is by blowing through a rubber tube nipped at about half an inch from the end with a screw clamp, but the sound is perhaps more like an *f* than an *s*.

There is reason to think that the ear, at any rate of elderly people, tires rapidly to a maintained hiss. The pitch is of the order of 10,000 per second.

RAYLEIGH.

Terling Place, Witham, Essex.

An Application of Mathematics to Law.

I WOULD not have troubled you with further correspondence on this subject but for the fact that Mr. Potts's letter (April 24, p. 187) illustrates in a remarkable way the value of a knowledge of the fundamental principles of mathematics when possessed by persons occupied in work often apparently of a very unmathematical nature.

Mr. Cripps (May 15, p. 270) appears to belong to the unfortunately too prevalent class of individual who mistakes algebra for mathematics, and he bases his objection entirely on the purely algebraic equation $I=M+i$. He completely overlooks the fact that Mr. Potts's method is based entirely on the great and powerful conception of *functionality*. But if I understand Mr. Potts correctly, the problem in which he is an expert consists in determining the forms and characteristics of certain functions, and not in the mere numerical solution of equations. G. H. BRYAN.

Overheated Water.

THE experiment of Dufour, in which drops of water were suspended in a mixture of linseed oil and oil of cloves, and heated to 120° C. without boiling, is seldom repeated for class demonstration, presumably owing to the difficulty of preparing a mixture of the oils exactly equal in density to water at the temperature named. The phenomenon may be shown with ease and certainty, however, by employing a mixture of four volumes of ethyl benzoate and one volume of aniline instead of the mixture of oils, the procedure being as follows:—Place 80 c.c. of ethyl benzoate and 20 c.c. of aniline in a beaker, and surround by a bath of glycerine or strong sulphuric acid. Heat the bath until the temperature of the mixture is 125° C., and then add 2 to 5 c.c. of freshly boiled water by means of a pipette. The water will sink at first, and rest on the bottom of the beaker; but on attaining the temperature of the mixed liquids it will break up with some violence into spheres of various sizes, which remain floating in the liquid so long as the equi-density temperature of 125° C. is maintained. It is advisable to place a cover over the beaker to prevent the fuming of the mixture.

For lantern projection, a copper vessel, square in section, and having two opposite sides of patent plate-glass, will be found satisfactory, glycerine being used to surround the beaker and the temperature raised gradually. CHAS. R. DARLING.

City and Guilds Technical College, Finsbury, E.C.

"Coal, and the Prevention of Explosions and Fires in Mines."

I MUST point out that some of the statements in your review of the above book in NATURE of April 24 are inaccurate.

"Great explosions do not, as Dr. Harger imagines, travel either exclusively or generally against the direction of the ventilating currents." What I say in the book (p. 78) which your reviewer is presumably criticising is this:—"All big dust explosions are similar to the one at Altofts. Ignition is followed by quiet combustion for 50–100 yards, then the wave of progressive combustion gathers speed, and finally attains a velocity approaching that of detonation, and races through the dust and air at a speed of 50–100 miles per minute. Such dust explosions always proceed *against* the current of air; sometimes they go the other way also, but seldom reach the working faces. As a rule the branch of an ignition which travels with the air current fails to develop violence," &c.

Every dust explosion in a mine on record *has* travelled against the air current, and the *reason* for this is clearly put in my paper on gob fires and the prevention of gob fires in mines, which your reviewer quotes, and also on pp. 98–100 in the book.

Your reviewer quotes Proc. Roy. Soc., vol. xxviii.,

p. 416, to show that a mixture of Ferndale dust and air is probably explosive, but the Ferndale dust mentioned in my papers and book is from the anthracite seams, and it is generally admitted now that anthracite dusts and air are *not* explosive *when unmixed with firedamp*.

I think readers of NATURE will agree that it is not permissible to quote half a paragraph when the rest of it amplifies. JOHN HARGER.

Chemical Laboratory, Liverpool University.

WE take exception to Dr. Harger's statements, in the quotation which he gives from p. 78 of his book, that "dust explosions" such as Altofts "always proceed *against* the current of air," and that, "as a rule, the branch of an ignition which travels with the air-current fails to develop violence."

The explosion at Altofts travelled to a distance of more than a mile in No. 1 chain road in the same direction as the air current had been previously travelling, and produced a greater amount of wreckage in that heading than in any other part of the mine. It did not reach the faces at any point, nor did it enter the return airways, for the reasons plainly set forth in Proc. Roy. Soc., vol. xlii., p. 174.

In our experience explosions are invariably found to have penetrated into the faces wherever there has been an uninterrupted train of coal-dust leading to them; and they have, as a rule, failed to pass through the return airways where the latter have not been recently used as haulage roads, and where, consequently, the coal-dust has become mixed with a large proportion of shale dust. For instance, the composition of a sample of dust taken from the return airways at Altofts Colliery after the explosion was as follows:—

	Per cent
Moisture	4·40
Volatile matter other than moisture ...	10·37
Carbon (estimated)	15·64
Ash	69·59

The experiments since made, both at Altofts and Liévin, have shown that dust of this quality is incapable of propagating an explosion.

The reference to Proc. Roy. Soc., vol. xxviii., p. 416, in the review, was not intended to show that a mixture of Ferndale dust and air "*is probably explosive*," as Dr. Harger suggests, but that return air does not contain too little oxygen or too much carbon dioxide to prevent its ignition when mixed with coal-dust even of the same quality as that of Ferndale. There are no anthracite seams in Ferndale Colliery; all the seams consist of steam coal of high-class quality. THE REVIEWER.

Error in the Smithsonian Physical Tables.

I HAVE just discovered a very awkward error in Table 47, p. 35, of this valuable publication. The table is headed "Least Squares," and gives the values of the probability integral. To illustrate the error, an example will be best.

For argument 0·53, the table gives 0·55494, but this is really the value for the argument 0·54, and the same error runs throughout the table. An easy way to correct it is to increase by 0·01 each of the figures in the horizontal line heading the table.

My copy is dated 1896, and I do not know if the mistake has been set right since.

I am reminded that some years ago I wrote to NATURE to suggest that all discovered errors in tables should be sent to some official scientific body, which should annually publish corrections of them.

C. T. WHITMELL.

Hyde Park, Leeds, May 22.

ANTHROPOLOGY IN WEST AFRICA.[1]

WE welcome a report by Mr. N. W. Thomas on the people of the Awka district, Ibo country, Southern Nigeria. Mr. Thomas is the Government anthropologist and has already given us an interesting report on the Edo-speaking people.

The present report is divided into three parts; the first treats of the law and customs of the people, the second is a dictionary, and the third contains proverbs, narratives, and vocabularies.

The most interesting to the general reader is undoubtedly part i. In chapter ii. Mr. Thomas gives some most interesting demographic facts and figures. Referring to infanticide, he says:—

> In addition to this legal infanticide (the exposure of twins) . . . I have more than once heard that the first-born of every woman is killed; my informants were Roman Catholic missionaries, who certainly know the native and his ways, and my own statistics seem to bear out the statement.

This is very interesting, and bears out the principle common, evidently, to most West Africans, that the first-born belongs to the owner of the family (*i.e.* the dead father). He, as head of the family, is worshipped by his son, grandson, great-grandson, and great-great-grandson. He (the dead one) has need of followers in dead man's land, and claims this toll in exactly the same way as the owner of a goat will claim its first-born from the farmer who is looking after it for him.

The genealogical tables are of great interest, and, in spite of the fact that the number of wives to one husband varies from four to eight, "the proportion of boys to girls in the births was fifteen to eleven." But there are more grown-up females than males. Taking the statistics for living males and females among the Ibo (1218 males to 1340 females), we can only conclude that the mortality among boys is greater than among girls or that this majority is largely composed of widows. That husbands in such a country should have four to eight wives must deprive a great number of men of the luxury of a wife. Many chiefs tacitly acknowledge this want and have appointed females in each town or village to supply the need. But in spite of this precaution young bachelors are constantly committing adultery. Men with one wife in this district account for 760 male and 787 female children, men with four wives for 137 male and 113 females. This chapter is most instructive to those who are interested in the question of polygamy *versus* monogamy.

Chapter iii. is entitled "Religion," and, written by such a master of anthropology as Mr. Thomas, is a lesson to all students of religion in Africa. Those of our readers who have followed the development of this great colony will not have forgotten the suppression of the so-called juju at

[1] "Anthropological Report on the Ibo-speaking Peoples of Nigeria." By N. W. Thomas. Part i., Law and Customs of the Ibo of the Awka Neighbourhood, S. Nigeria. Pp. 161+xx plates. Part ii., English-Ibo and Ibo-English Dictionary. Pp. vii+391. Part iii., Proverbs, Narratives, Vocabularies, and Grammar. Pp. vi+199. (London: Harrison and Sons, 1913.)

Aro Chuku and the recent recrudescence of the horrible rites nipped in the bud by the District Commissioner. Mr. Thomas writes: "We have,

Fig. 1.—Mauri. From "Anthropological Report on the Ibo-speaking Peoples of Nigeria."

it is true, at the head of the pantheon a supreme god known as Čuku," who "seldom appears to figure in creation myths." The old men say that they knew nothing of Čuku before the coming of the white man. This may be quite correct, for our experience is that the idea of a supreme god is seldom reached by people living in the clan stage. To have a god like the Yoruba Olorun, or the Bini Osalubwa, people must have reached the kingdom stage of development. If the Aro Chuku juju had not been suppressed it is possible that the Ibos would be well on their way in their development of a great Ibo kingdom under the supreme god Chuku. It is rather remarkable that a trained anthropologist like Mr. Thomas should call the chief of Uri king in his chapter on priestly kings. The father of the family prays for his people, the head of the house does the same, the elected judge or head of a number of clans, or a tribe, does the same. The priestly office is there, but surely not kingship. At any rate, if the chief of Uri is not yet a king, it would appear that he, as a great spiritual leader, is on his way to kingship if his progress is not interfered with.

It is impossible to do justice to this part of Mr. Thomas's report in the space available. All his chapters are intensely interesting.

Part ii. is the dictionary, the material for which was, Mr. Thomas says, collected in 1911 from natives of Awka and Onitsha. It seems a pity that the vast and interesting material collected by the various missionary societies has not been taken into account. They must have dictionaries, at any rate in manuscript, and they have made translations in the Ibo language. We notice that Onitsha is spelt Oniča, and that Mr. Thomas, instead of adopting the geographical system of spelling as officially gazetted, has given us a system of his own—a good one, no doubt, but a new one. There are thus three systems of writing in Nigeria—the system adopted by the missionaries, the system enforced on officials by the Government, and Mr. Thomas's system.

Mr. Thomas has shown his caution by omitting the words "God" and "Čuku" from his dictionary.

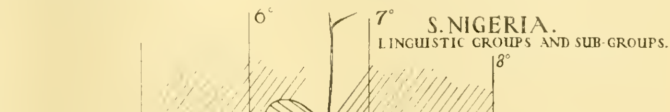

Fig. 2.—From "Anthropological Report on the Ibo-speaking Peoples of Nigeria."

There are no words beginning with the English *c* sound in the dictionary, and all the words under *č* in the dictionary are to be pronounced *tch*, or as the *c* in "church." Why, then, should not the simple *c* stand for this sound? The new *č* seems unnecessary.

The letter *j* is to be pronounced as *j* in "judge," but it is to be written *j*. In the Yoruba dictionary the sound *sh* is written *ś*. This sign, Mr. Thomas says, stands for the cerebral *s*, and he writes the *sh* sound *š* instead of *ś*. There will be great gnashing of teeth in Nigeria until the Government takes the matter up and appoints a commission to settle which system is to be maintained.

Part iii.—Needless to say, Mr. Thomas has treated the proverbs, narratives, and grammar scientifically. The folklorist will revel in them. The student of the Ibo language will be greatly helped by the literal translations of the stories and by the vocabularies.

Mr. Thomas divides the languages in Southern Nigeria into four groups.

(*a*) Yoruba with Igara and Ṣekri (Jekri).

(*b*) Edo (Ado), including Sobo, Bini, Kukuruku, and Esa (Ishan).

(*c*) Ibo with Ika and numerous other languages.

(*d*) Efik and Ibibio.

The Government of Southern Nigeria is to be congratulated on the production of these valuable reports by its Government anthropologist, and we hope that Mr. Thomas will soon give us equally interesting books about the Ibibios and Efiks.

THE INTERNATIONAL ASSOCIATION OF ACADEMIES.

THE fifth meeting of the International Association of Academies was held at St. Petersburg during Whit-week. Of the twenty-two academies which constitute the association, twenty-one took part in the proceedings, the British Academy being the only society which was not represented. The delegates of the Royal Society were: Sir David Prain, Prof. Arthur Schuster, Prof. Sherrington, and Prof. Turner.

Among the new proposals the most important was that submitted by the Berlin Academy for an international investigation of the problems connected with volcanoes. It is not intended to form an international institute similar to that for geodesy or seismology, but rather to encourage each country to take its share in the investigation by establishing, if desirable, a separate institute of its own. An autonomous commission of the International Association of Academies could then act as connecting link between the different institutions. A small committee was nominated to make more definite proposals to the next assembly, and was authorised to enter into communication with the separate academies, each being asked to nominate a representative, and thus form a larger body to assist the committee in formulating a scheme of joint investigation.

An interesting proposal came from the Imperial Academy of St. Petersburg. The want is apparently felt in several branches of science to have a more scientific scale and definition of compound colours than exists at present. It ought to be possible to define the colour, *e.g.*, of a particular leaf, the skin of an animal, or a new chemical compound in such a way that everyone could obtain an accurate idea of it. Books, containing numbered samples of the different shades of the various colours, suffer from the defect that they are subject to change; and though in practice it may be found necessary to use such books as secondary standards, some means should be found to compare them from time to time with a more scientific scale of colours. The committee appointed to discuss this question consists of: Prince Galitzin, Sir Wm. Abney, and Messrs. Nasonow, Saccardo, Schuster, and Walden.

It has become the habit of the association to give its moral support to undertakings which it considers valuable; such support often enabling those more directly interested in them to obtain from other sources the financial help they need. A proposal to encourage in this fashion an organisation instituted at Frankfort by Prof. Brendel for calculating the orbits of small planets was adopted on the motion of the Académie des Sciences of Paris.

An enterprise to publish annually a table of physico-chemical constants had already been supported at the meeting at Rome; and though the utility of the work was subjected to some criticisms, it appeared that there was a real demand for it, and it received renewed support at the present assembly.

A report was presented by Prof. Turner on the progress of the work connected with the nomenclature of features on the surface of the moon. Although the committee has suffered much through the deaths of Prof. Franz and Mr. Saunders, there is good hope that the work will soon be completed and prove a most useful help to students of lunar phenomena.

A question of wider interest was raised by the French proposal to discuss the possibility of a reform of the calendar. This includes not only the question of fixing the date of Easter, but also more sweeping changes intended to divide the year into four equal quarters (at present the first six months consist of 181 and the second six months of 184 days) and the intercalation of an occasional extra day in the week, introduced to secure that the same day in each year should always be associated with the same day of the week. A committee was appointed to consider this matter.

The above, referring entirely to the work of the section of science, does not exhaust the questions which were raised and discussed before that section. The section of letters also had a successful meeting.

The association is still young, and consequently has to devote some attention to the statutes and regulations for its procedure, which have not yet become crystallised. A proposal to appoint a permanent secretary was strongly supported by some and opposed by other academies. It will come up for decision at the next meeting, which will be held three years hence in Berlin, after discussion by a standing committee charged with the general revision of the statutes.

Proposals to elect the Royal Society of Edinburgh and the Finnish Academy of Helsingfors as members of the association were presented by the Royal Society of London and the Imperial Academy of St. Petersburg respectively. As several of the delegates were without definite instructions from their academies, the proposals will have to be submitted to the constituent bodies and voted upon by correspondence.

It is needless to say that the social functions of the meeting were carried out admirably and with lavish hospitality. Dinners and evening parties followed each other almost too continuously, and the ladies accompanying the delegates will not forget the manner in which they were hospitably entertained throughout their stay in St. Petersburg. But this account is only intended to deal with the scientific aspect of the meeting, and a brief reference only can therefore be made to the visit to the Tsar's palace at Tsarkoé Sélo, during which the delegates were individually presented to the Emperor of Russia and afterwards entertained at luncheon. ARTHUR SCHUSTER.

PROF. JAMES GORDON MACGREGOR, F.R.S.

PROF. J. G. MACGREGOR, of Edinburgh University, died suddenly and unexpectedly on the morning of Wednesday, May 21, shortly after he had risen, apparently in his usual health. It was known, of course, both to himself and his friends that his heart was not in the healthiest condition, but up to the moment of his death no really grave symptoms had declared themselves.

Prof. MacGregor was born on March 31, 1852, at Halifax, Nova Scotia, where his father had been a well-known clergyman. He early showed mental abilities of a high order; and in 1871 he graduated M.A. at Dalhousie College, Halifax, with the highest distinctions in all departments. He was awarded the Canadian Gilchrist scholarship, the condition of which required him to continue his studies and take a degree in London University. He decided to follow out physical and chemical science, and in 1871 entered himself as a student of science in the University of Edinburgh. He began what promised to be a most distinguished career; but unfortunately he broke down in health and was forbidden to work for competitive honours in the classes. During his second winter he spent much of his time in Prof. Tait's laboratory, and in conjunction with Ewing (now Sir Alfred) he measured the electrical resistance of certain saline solutions. The paper was soon afterwards published in the Transactions of the Royal Society of Edinburgh, and it may be regarded as giving the impulse which led MacGregor to follow up the line in which his best original work was done.

He spent the better part of two years in Leipzig in the laboratory of Gustav Wiedemann, and carried out some investigations in the electrical resistance of stretched silver wires. He gained his doctorate of science in 1876, and was immediately thereafter recalled to his native town as lecturer in physics in Dalhousie College. This he held for only one year, and from 1877 to 1879 he filled the important post of physical science master in Clifton College. The tragic death, as the result of a shooting accident, of one of the Clifton College masters, beside whom MacGregor was sitting at the moment of the accident, seriously affected his health at the time, compelling him to stop work entirely for several months. Meanwhile the Dalhousie College lectureship had developed into the Munro chair of physics, and MacGregor, undoubtedly their most promising alumnus, was invited to become professor. For twenty-two years he filled this post to the educational advantage of his native town. He took an active share in the founding of the Royal Society of Canada, in the Transactions of which some of his most important papers are published. He also keenly interested himself in the welfare of the Nova Scotian Institute of Science.

In 1887 MacGregor brought out a text-book on kinematics and dynamics (Macmillan and Co.). At the time of its publication it occupied an intermediate position between the elementary text-books and the treatise of Thomson and Tait, whose methods, indeed, MacGregor largely followed. The book had outstanding merits, and covered not only what is ordinarily understood by dynamics, but much also of hydrodynamics and elasticity. In 1909 appeared a third edition, considerably altered and improved.

The writing of this book turned MacGregor's mind to the difficult question of the foundations of dynamical science; and his conclusions were given in several papers, some of which appeared in the Transactions of the Royal Society of Canada and others in the *Philosophical Magazine*. These are characterised by clearness of apprehension of the questions at stake and by a logical statement of his own views.

On the retirement of Prof. Tait in 1901 from the chair which he had filled with such conspicuous success for forty years, Prof. MacGregor was elected his successor. During the twelve years of his tenure of this post MacGregor's chief work outside the ordinary duties of his chair was to develop the natural philosophy department and bring it into line with modern requirements. The transformation of the old infirmary building into a well-equipped laboratory demanded a vast amount of detailed consideration; and after two years of careful planning the new department was opened in 1907, not in the completed state designed by MacGregor, but sufficiently developed for a start to be made. With later additions and developments the whole combined departments of natural philosophy and applied mathematics remain as a lasting monument to Prof. MacGregor's energy, zeal, and forethought.

During the last few years Prof. MacGregor had been actively engaged in appealing to Prof. Tait's old students for subscriptions towards a new chair on the mathematical side of natural philosophy, to be called the "Tait Chair."

Prof. MacGregor's original contributions to scientific literature other than those already indicated are mainly concerned with electrical conduction, ionisation, densities, and freezing-point depressions of solutions. These are published chiefly in the Transactions and Proceedings of the Royal Society of Canada, the Royal Society of Edinburgh, and in the *Philosophical Magazine*. He also wrote interesting addresses on educational subjects of a more general nature, and a few years ago published for the use of the students a pamphlet on physical laws and observations.

Prof. MacGregor was an enthusiastic teacher, and spared neither time nor trouble for the sake of his students. His accessibility endeared him to all. Busy though he was at all times, he was ever ready to lay aside his personal work, however pressing, so as to discuss any difficulties his students might have. His was a sunny, genial nature, finding pleasure in ministering to the needs of others; and there was no trouble too great which he would not take on behalf of his friends.

C. G. Knott.

NOTES.

We regret deeply to announce that Lord Avebury died on May 28, at seventy-nine years of age.

The annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 7.

The Croonian lecture of the Royal Society will be delivered by Dr. Robert Broom on Thursday, June 5; the subject will be "The Origin of Mammals."

We learn from the *Revue Scientifique* that the mathematical works of the late Henri Poincaré are to be published by the firm of Gauthier-Villars, under the auspices of the Minister of Public Instruction and the Paris Academy of Sciences.

At the meeting of the Royal Meteorological Society on Wednesday, May 21, Dr. V. F. K. Bjerknes, professor of geophysics in the University of Leipzig, and Dr. Hugo Hergesell, president of the International Commission for Scientific Aëronautics, Strassburg, were elected honorary members of the society.

The American Association for the Advancement of Research by Women has awarded the Ellen Richards prize of 1000 dollars to Dr. Ida Smedley (Mrs. MacLean) for her work on the biochemical synthesis of fatty acids. The prize is offered biennially, and was last awarded in 1909, when the successful candidate was also an Englishwoman, Dr. Florence Buchanan.

The fourth International Congress for the Hygiene and Salubrity of Dwellings is to be held at Antwerp on August 31–September 7. The congress will be divided into four sections: the hygiene of emigrants, colonial hygiene, hygiene of ports and ships, and the development of towns from the hygienic point of view. Persons desiring to take part in the congress should communicate with the treasurer, Mr. A. Cols, notary, Willem Tell Street, 3, Antwerp.

The president of the Royal Society has received from the Portuguese Legation subscriptions amounting to 21*l.* 5*s.* forwarded by the Society of Medical Science of Lisbon as a donation to the Lister Memorial Fund. A sum of 867 dollars has been collected by Dr. W. W. Keen, of Philadelphia. Further donations intimated from foreign countries include:—University of Paris, 500 francs; University of Lyons, 100 francs; Société de Chirurgie of Lyons, 100 francs; faculty of medicine of the University of Munich, 100 marks; faculty of medicine of the University of Breslau, 110 marks; and Stockholm Medico-Chirurgical Society, 5*l.* A donation of 10*l.* has been received from the University of Calcutta.

We are glad to be assured by Prof. Sampson, Astronomer Royal for Scotland, that the damage to instruments due to the explosion of a Suffragette bomb at the Royal Observatory, Edinburgh, on May 21, was happily insignificant. The bomb was placed on the floor below that of the west dome. The floor of the west dome is a heavy one, and thoroughly protected the 24-in. reflector and Cooke photovisual above it. The driving clock for these telescopes was near the bomb, but appears uninjured except in respect to its glass case. On the floor below falling plaster smashed the glass case of the Cooke drum chronograph, which is at present out of use. The disturbance was recorded by the Milne seismograph at 0h. 57·2m. as a small, sharp oscillation of approximately 0·1″ semi-amplitude.

Since 1908 the Somersetshire Archæological and Natural History Society has engaged in excavation work at Glastonbury Abbey, and year by year results of great historical and archæological importance have been secured. Last year, the society, at the request of the Abbey trustees, appointed a special committee to undertake the supervision of the future excavation work, and the researches will proceed systematically. An income of 250*l.* a year is needed to carry out the work efficiently, and the funds hitherto raised by subscriptions and donations are exhausted. The committee now makes a further appeal for money. Subscriptions or donations may be sent to the treasurer of the Glastonbury Abbey Excavation Fund, The Castle, Taunton, Somerset.

At the annual meeting of the Royal Geographical Society on Monday last, in addition to the presentations made to Lady Scott and Mrs. Wilson of the awards voted to their husbands, who died in the Antarctic, and that made to Lieut. Campbell, which are referred to elsewhere, the following awards were made:—The Victoria medal to Col. S. Burrard, Surveyor-General of India; the Murchison award to Major H. D. Pearson, for his work in the Sudan; the Gill memorial to Miss Lowthian Bell (Mesopotamia, &c.); the Cuthbert Peek grant to Dr. Felix Oswald (Armenia); and the Back bequest to Mr. W. S. Barclay (South America). In his anniversary address, Earl Curzon, as president, referred to the momentous events of the past year in polar exploration, and made the interesting announcement that the society expects presently to receive into its charge

Scott's diary and some of Dr. Wilson's beautiful water-colours. He mentioned the important work projected in the Arctic by Amundsen, Stefánsson, and Macmillan, and briefly reviewed geographical work elsewhere. He had naturally a good deal to say on the new establishment of the society at Kensington Gore, viewed with optimism the important bearing which the better conditions under which the society will now work should have on the progress of geographical study in this country, and discussed the new meeting-hall which he clearly expects to see built. At the annual banquet in the evening, Sir E. Grey and Lord Milner, among the speakers, both testified emphatically to the importance of geographical teaching and study, in relation to the maintenance of empire, on their now broadened basis of the bearing of physical conditions upon human activities.

The annual congress of the Royal Institute of Public Health was held in Paris, May 14–19, Prof. W. R. Smith, the principal of the institute, presiding. Important papers on tuberculosis were contributed by Prof. Delépine ("Milk-borne Tuberculosis") and Dr. Lister ("The Future of State Campaigns against Tuberculosis"), who considered that the future of campaigns against the disease was a matter more for the social reformer than for the public health officer. Mr. L. Gaster lectured on artificial illumination, making many useful suggestions on the nature of the illuminant to be employed and its methods of use. Dr. Bertillon arranged an exhibit showing the mortality in a number of trades and employments, contrasting those of Great Britain with those of France and one or two other countries. The members of the congress were most cordially received, and visits were arranged to all the important institutions, municipal and public, factories, and so on. The Harben gold medal of the institute for 1912 was presented to Dr. Roux, of the Pasteur Institute.

This year the Société Helvétique des Sciences Naturelles will hold its meeting at Frauenfeld on September 7–10. Among the lectures announced already the following may be mentioned:—Prof. Grubenmann, of Zurich, "Ueber die Entwicklung der neuern Gesteinslehre"; Prof. Fuhrmann, of Neuchâtel, "Voyage d'études scientifiques dans les Cordillères de Colombie"; Dr. de Quervain, of Zurich, "Die Durchquerung Grönlands durch die schweizerische Expedition und deren Ergebnisse"; Prof. Keller, of Zurich, "Die Tiergeographie des Kaukasus"; Prof. Maillefer, of Lausanne, "Les lois du géotropisme"; Prof. Rikli, of Zurich, "Pflanzengeographische Studien über die Kaukasusländer"; and Prof. Dutoit, of Lausanne, on a subject of physical chemistry. On September 9 the Swiss mathematical, physical, chemical, geological, botanical, and zoological societies will also hold their annual meetings at Frauenfeld. A number of attractive excursions have been arranged for visitors. Persons desiring to attend the meeting of the Swiss Association should communicate with M. A. Schmid, president of the committee, at Frauenfeld.

The Board of Agriculture and Fisheries has issued a circular intimating that numbers of salmon smolts and kelts have been "marked" in various rivers, by means of a wire, or a wire and label, attached to the dorsal fin. Rewards will be paid for the return of these marks, accompanied by the particulars of sex, length, weight, and condition of the fish to which it was attached, and by a few scales taken from the body of the fish behind the gill-cover. The object of these experiments is to trace the migrations of the fish, mainly the length of the period spent in the sea. The object of the removal of the scales is to determine, from a microscopical examination of the latter, the age of the fish and its history as regards sexual maturity and previous spawning acts. Anglers and others interested in the study of the salmon will welcome the instigation of these experiments by the Board. Investigations of a similar kind have been made so far mainly by private persons in this country, but with the resources at the command of the Board very valuable results should be obtained. The investigation is, of course, one which depends for its success upon the cooperation of sportsmen and fishermen, and we cordially recommend that this assistance be rendered.

On May 23 a communication was made to the Hon. Society of Cymmrodorion, by Mr. T. A. Acton and Mr. W. Burton, descriptive of the excavations that have been conducted during the last three years at Holt, near Wrexham. Mr. Acton has discovered the site of a tile and pottery works of the twentieth Roman Legion, and he gave a review of the discoveries of the foundations of buildings for housing the workers and probably the garrison of what must have been practically a frontier post, and also of the excavations of a series of potters' kilns. Thousands of fragments of Roman tiles and pottery have been excavated from the site, and are now in process of classification. Mr. William Burton explained the construction of the kilns, which are fortunately so well preserved that the leading features of the construction of both the circular and rectangular kilns used by the Romans in various parts of the empire are now clearly established; they foreshadow in a remarkable way the main principles of modern kiln construction. Mr. Burton exhibited three models of different types of kilns made from careful measurements of the remains, and these will be deposited ultimately in the British Museum.

The census report of the Nicobar Islands for 1911, just published, gives a good example of the custom of Couvade or "hatching." For some days or even weeks before the wife's confinement, the people in the hut, as a form of sympathetic magic, unloose all the cane and fibre lashings of their spears or vessels. During the first month after the birth of his first child the father is treated as an invalid. On subsequent occasions this lasts only one or two days. He is looked after and fed by his wife, and may not bathe or chew betel. These rules, which are enforced by the Menluanas, or medicine-men, are so irksome that it is believed their observance accounts for a widespread avoidance of maternity among the women.

The classical account of the pagan tribes of the Malay Peninsula by Messrs. Skeat and Blagden is being gradually supplemented by later inquiries among this interesting people; but these investigations only serve to prove the correctness of the earlier record. Mr. L. H. N. Evans now publishes in the Journal of the Federated Malay States Museum, which takes the place of the Perak Museum Notes, an account of the Besisi of Tamboh, Kuala Langat, Selangor. Their advance in culture is illustrated by the fact that they are now able to ride bicycles, which they borrow from the Chinese. Mr. Evans made a considerable ethnographical collection, including specimens of two methods of fire-making—by the saw and drill—which are being replaced by the use of matches and the flint and steel. As an example of culture contact, two ingenious forms of animal traps are now found in use from Nepal and Assam eastward through Indo-China and the Malay Peninsula, and all over the Greater Sunda Islands.

The researches that are being carried out at the present time, with so much patience and minuteness, upon disease-producing parasites, though undertaken primarily with practical aims in view, are helping to accumulate in many cases data of great value from a purely scientific and theoretical point of view. It is becoming, for example, increasingly evident that the pathogenic trypanosomes represent a group of incipient species in process of coming into being, in many cases differentiated physiologically, but not morphologically. From this point of view the human trypanosome generally known as *Trypanosoma rhodesiense* is very interesting. It is possible that it is an old-established species lately discovered; but it is far more probable that it has become but recently differentiated, and that it represents either a race of *T. brucii* that has acquired the power of living in human blood, or a race of *T. gambiense* adapted to transmission by *Glossina morsitans*. The former view has been advocated by Bruce and his colleagues, of the Royal Society's commission working in Nyasaland; but Stephens and Fantham, in a paper in the Annals of Tropical Medicine and Parasitology (vol. vii., No. 1), find it difficult to distinguish between *T. rhodesiense* and *T. gambiense* by means of measurements. The chief distinctive character of *T. rhodesiense* is the presence of the so-called posterior nuclear forms, which are studied by Blacklock in a memoir in the same journal; these forms have been found, however, in other species of trypanosomes, including *T. brucii*.

We have received a report by Prof. E. C. Starks, issued in the Leland Stanford Junior University Publications, on the fishes collected by the second Stanford expedition to Brazil, in which several species are described as new. A report has also reached us on the fishes of certain tanks in Bengal, drawn up by Mr. T. Southwell and Capt. R. B. S. Sewell, and published at Ranchi by the Bihar and Orissa Department of Agriculture.

The March issue of the Proceedings of the Philadelphia Academy contains a report on parasitic worms infesting the animals in the local zoological gardens. The average number of infestations is about forty-five per annum, but in 1910 there was a rise, due to the prevalence of cestodes in birds, while a second rise, owing to nematodes in parrots and perching birds, occurred in the following year. Among mammals Carnivora are much more heavily infested than any other order, monkeys, ungulates, and marsupials making nearly a dead-heat for second place. The new observations confirm previous statements that nematodes are the most common parasites, these being followed by cestodes, flukes, and Acanthocephali, in the order named.

In *The American Museum Journal* for March Mr. Barnum Brown describes, with a good series of photographs, the discovery at Red Deer River, Alberta, of a new crested dinosaur, now named Saurolophus, "the crested saurian." In life this animal was about 32 ft. in length, and stood about 15 ft. in height when erected. Like Tracodon, it was a herb-eater, and unable to defend itself from the contemporary flesh-eating Albertosaurus, except by its power of escaping danger by swimming. Great numbers of these creatures lived in the prehistoric coastal marshes, and in a single quarry on the Red Deer River bones of several hundred individuals, mostly of this kind, have been washed out of the bank. Another set of bones discovered in the same district represents the skeleton of another new dinosaur coming from an older formation, and probably an ancestor of Saurolophus.

The first of a series of studies on the evolution of the teeth of primates, by Dr. L. Bolk, professor of anatomy in the University of Amsterdam, has been published (G. Fischer, Jena, 1913, price 5 marks). A completely new interpretation is given of the relationship between milk and permanent teeth. We have hitherto regarded them as belonging to different epochs of evolution—the milk teeth representing a primary dental outfit, the permanent a secondary acquisition. Prof. Bolk, from a prolonged inquiry into the developmental stages of the teeth of reptiles and mammals, has accumulated evidence to show that both reptiles and mammals have arisen from a stock which was furnished with three rows of teeth, all of which came into use at the same time. In both reptiles and mammals the outer row is represented by vestiges—the so-called pre-lacteal dentition. In reptiles the middle and inner rows persist and come into use together. In the higher or diphyodont mammals the middle rows come into use first, forming the milk dentition, while the inner is delayed in its appearance, and forms the permanent set of teeth. In lower or monophyodont mammals both middle and inner rows of teeth—that is to say, milk and permanent teeth—come into place and use together, forming an apparently linear series. Prof. Bolk's hypothesis promises to simplify our conception of the evolution of mammalian teeth, and explains many facts which were formerly obscure.

Mr. W. Engelmann, Leipzig, has lately issued parts 55, 56, 57, and 58 of "Das Pflanzenreich." This magnificent *regni vegetabilis conspectus* is making rapid progress, though up to the present time only one group (Sphagnaceæ) of cryptogamous plants has been dealt with. Heft 55, by Prof. Engler, begins the account of the Philodendroideæ section of the large family Araceæ by Engler and Krause, and is unusually well and fully illustrated with new figures. Heft 56, by Dr. F. Kranzlin, forms a self-contained monograph of the "Indian shot" family, Cannaceæ, and concludes the treatment of the interesting order Scitaminales, the remaining three families of which (Musaceæ, Zingiberaceæ, Marantaceæ) have already been described by Schumann; in his introduction the author gives an account of the various interpretations which have been put forward of the structure of the outer floral organs in Canna, the sole genus in the family. In Heft 57, Dr. Pax, assisted by Käthe Hoffmann, continues the monograph of the large and difficult family Euphorbiaceæ; in addition to figures of many of the species, there is given a useful table showing the geographical distribution of the genera belonging to the section (Chrozophorinæ) dealt with in this part. Heft 58, by G. Grüning, gives the Stenolobeæ section of the same family.

WE have received a copy of vol. xlviii., No. 8, of the Proceedings of the American Academy of Arts and Sciences, consisting of an extensive memoir by Mr. J. W. Hotson on culture studies of fungi producing bulbils and similar propagative bodies. In this paper the author brings together the scattered references in mycological literature to the occurrence in various fungi of these propagative bodies, which are cell-masses ranging from spore-like structures to large sclerotium-like forms, and indeed shading gradually into these two definite and distinct types (spore and sclerotium) of reproductive body. After describing in detail, with numerous excellent figures on twelve plates, the structure and development of bulbils in the various species examined during his long-continued culture experiments, the author discusses the morphological significance, distribution, and occurrence of bulbils in fungi. He concludes that in most cases, if not in all, these bodies are not to be regarded as abortive spore-fruits (ascocarps), but rather as an auxiliary method of reproduction that has been interpolated in the life-history of certain fungi without definite relation to other methods of reproduction they may possess, or that if they have in reality been derived from some other reproductive body, this was more probably some form of non-sexual spore rather than the primordium of an ascocarp.

THE Memoirs of the Indian Meteorological Department, vol. xxi., part 7, contain an interesting inquiry into the cold weather storms of northern India by Dr. G. T. Walker and Rai Bahadur Hem Raj. It is pointed out that the storms in question, which occur between December and April, are of considerable agricultural importance, and that it is extremely desirable that their origin should be ascertained, the view that these rain-bearing disturbances are generated over the arid districts of Persia and Baluchistan being by no means free from difficulty. An examination of charts recently prepared by the Meteorological Service of Egypt for the years 1906–12 shows that about seven-tenths of the disturbances which affect north-west India in those months are continuations of depressions from southern Europe, but the paths of the depressions vary considerably from year to year. In order to confirm the origin of most of the storms without a large expenditure of labour in preparing charts, Dr. Walker had recourse to statistical methods. He says that if these storms pass over Syria or Asia Minor it is to be expected that severe winters with much precipitation in these areas will tend also to be severe winters in north-west India. "A calculation was accordingly made of the correlation coefficients of the seasonal rainfall in north-west India with those of rainfall in places to the west for which records were available." The evidence shows that the winter seasons in the west of Asia Minor, in Syria, and in Malta have a closer resemblance to those of north-west India than do the winter seasons of Persia and Mesopotamia.

IN his presidential address to the Institution of Mining and Metallurgy, delivered on March 13, a copy of which has just reached us, Mr. Bedford McNeill devoted his attention more particularly to the statistics of production of the more important metals, laying especial stress upon the precious metals. He showed that the production of metals was increasing at a rate quite unexampled in the history of the world, the percentages of increase during the decade ending in 1911 ranging from 29 in the case of lead up to no less than 513 for aluminium, whilst it was 58 for iron and 68 for copper. The metal miner is therefore supplying the world with the metals used in the arts upon an enormously greater scale than ever before. As regards the precious metals, it is shown that within the above-named decade the production of gold has increased by 79 per cent., and that the world's annual output of gold is now more than equal to the total production for the sixty years preceding the year 1700. Mr. McNeill shows that this increase of production is to some small extent counteracted by the remarkable absorption of gold that has been taking place for some years past in India, and to a smaller extent also in Egypt. The production of silver has also undergone an increase, though less than gold, the increase during the decade 1901–11 being 41 per cent.; the actual production of silver during that period was ten times as great as that of gold, though this proportion is one that appears to fluctuate considerably from time to time.

WHEN our knowledge of the mean depth of the oceans was less extensive than it is now, it was supposed that a close approximation along certain lines was given by the velocity of seismic sea-waves. The formula (Lagrange's) used for the purpose was $v=\sqrt{(gh)}$, where v is the mean velocity of the waves and h the mean depth along the line of ocean traversed by them. It was shown, however, by Dr. Davison (*Phil. Mag.*, vol. xliii., 1897, pp. 33–36) that, when the depth is variable, the formula gives too great a depth, and that it should be $v = s \Big/ \int \frac{ds}{\sqrt{(gh)}}$, s being the distance from the epicentre. Prof. Rudski ("Physik der Erde," 1911, p. 340) suggested the formula $v=\frac{1}{s}\int \sqrt{(gh)}ds$. Prof. G. Platania has recently made a comparison of the results given by the three formulæ in the case of the Calabrian earthquake of October 23, 1897, the sea-waves of which were registered by the mareographs at Messina and Catania (*Boll. Soc. Sism. Ital.*, vol. xvi., 1912, pp. 166–174). The actual mean velocity was 102 metres per second, while the values given by Davison's, Rudski's, and Lagrange's formulæ were respectively 109, 114, and 120 metres per second.

VOL. xiii., part 2, of the Proceedings of the Nova Scotian Institute of Science contains an account, by Mr. J. H. L. Johnstone, of measurements of the specific resistance of ice at temperatures between 0° and −19° C., made by a new method, in which the effects of electrolytic polarisation were eliminated. The values obtained agree fairly well with those obtained by Profs. Ayrton and Perry, using a different method, and show that the value of the temperature coefficient is very much higher than that of ordinary electrolytes and decreases in value as the temperature departs from 0°. The same number of the Proceedings also includes an interesting account of the sacred trees of India, by Capt. J. H. Barbour.

WE have received a copy of the reprint of the Carnegie Institution of Washington paper on the magnetic survey work in southern and central Africa carried out in 1908 and 1909 by Prof. Beattie, of the South African College, Cape Town, and Prof. Morrison, of Victoria College, Stellenbosch, who for the time necessary were made officials of the Carnegie Institution. The cost of the work was defrayed by the Carnegie Institution, 2000*l*., the Royal Society, 250*l*., and Sir L. S. Jameson and Sir L. Mitchell, 100*l*. The survey covers the regions between the Zambezi and the Nile, including parts of north-eastern Rhodesia, the Congo, German East Africa, Uganda, Nyasaland, and British East Africa, with further observations in Cape Colony and German South-West Africa. Throughout most of the journey the only means of conveyance was by native carriers, and the history of the expedition reads like a chapter of Livingstone's travels. We offer our congratulations to Profs. Beattie and Morrison on the successful accomplishment of an important and much-needed piece of magnetic survey work.

SEPARATE copies have reached us of a considerable number of papers which have been published by the staff of the Reichsanstalt during the present year. Dr. F. Henning has compared the platinum resistance with the hydrogen thermometer at temperatures between 0° C. and −193° C. He finds that Callendar's formula connecting the two holds only down to −40° C., and proposes another formula, which holds over the whole range. Drs. K. Scheel and W. Heuse have determined by the continuous-flow method the specific heats at constant pressure of helium, hydrogen, nitrogen, oxygen, air, and carbonic oxide, at temperatures down to that of liquid air. The specific heats of helium and hydrogen increase with increase of temperature, the others decrease. In connection with these researches a thermostat suitable for low temperatures has been devised by Dr. Henning. It depends on the passage of a stream of liquid air through a suitable liquid, as, for example, petroleum ether. The air evaporates in the liquid, and the rate of evaporation determines the temperature to which the liquid is cooled. The former papers will be found in the March and April numbers of the *Annalen der Physik*, and the last in the February number of the *Zeitschrift für Instrumentenkunde*.

IT has long been known that the photometry of sources of light widely differing in colour is rendered difficult by the peculiarities of the eye, especially at low illuminations. Until recently this was not of much practical importance, since most of our commercial illuminants yielded continuous spectra and light of substantially the same tint. Now, however, things are changed. A recent communication by Messrs. Broca, Jouast, De la Gorce, and Laporte (*Bull. Soc. Int. des Electriciens*, February, 1913) shows the perplexities likely to be met with in comparing such sources as the mercury-vapour lamp and the new neon tube. The former contains only yellow, blue, and green light, the latter only red and orange rays between 0·585 μ and 0·640 μ. The authors meet with differences of 100 per cent. or more, according to the illumination of the photometer screen. Similar discrepancies are caused by the personal errors of different observers. To these difficulties, due to the colour of the light, must be added those arising from the fact that the light is not a point, but a tube of considerable dimensions, so that the ordinary inverse square law of photometry does not apply. Another interesting observation is that objects illuminated by the neon light appear more sharply defined than in the case of ordinary illuminants. The reason would appear to be that the monochromatic nature of the light avoids the results of chromatic aberration in the eye.

SOME new experiments on the preparation and properties of pure alcohol are described in the Chemical Society's Journal by Mr. R. W. Merriman. The density of the pure alcohol was established for about forty samples as 0·80628 at 0°/4°. It was shown that freshly burnt quicklime prepared from marble is a better drying agent than metallic calcium, which produces no improvement in alcohol dried by lime. In distilling the alcohol from the lime it is necessary to reject the first and last fractions; the latter have a high density, which is attributed to partial dehydration of calcium hydroxide as the temperature of distillation rises from 80° to 100° on the water-bath.

A "NEW Iron Bacterium" is described by Mr. E. M. Mumford in the Transactions of the Chemical Society. It was discovered in the Bridgewater Canal tunnels at Wasley, Lancashire, where the water contains much iron derived from colliery pump water. The new bacterium appears to have a twofold action, an aërobic action whereby it precipitates ferric hydroxide from iron solutions, and an anaërobic action which transforms the ferric hydroxide into bog iron ore with partial reduction of the iron to a ferrous state. It is probable that the deposits of bog ore are due to this organism rather than to the higher bacteria, since the latter have not the facultative power necessary to dehydrate and reduce the ferric hydroxide to bog ore.

THE English Ceramic Society has recently issued the twelfth volume of its Transactions, and is to be congratulated on the good work which it continues to do in furthering the application of scientific methods to so important an industry. Attention may be directed specially to a paper by Mr. A. J. Campbell in which the application of "surface combustion" to pottery practice is suggested, and to a description by Dr. W. R. Ormandy of an "Electrical Process for the Purification of Clays." This consists in partially coagulating the emulsified clay by the addition of electrolytes, and then further purifying the emulsion by passing it through a vessel containing electrodes differing in potential by 60 to 100 volts. The chief impurities are electropositive, and can thus be removed, even when present in very fine particles. The clay-substance is electronegative, and is laid down in the form of a continuous blanket $1\frac{1}{2}$ yards wide and $\frac{1}{4}$ in. thick. It is deposited in a remarkably dry state with only 18 to 20 per cent. of water, and may contain as much as 99·5 per cent. of china-clay substance.

MESSRS. J. AND A. CHURCHILL have nearly ready an English translation of the Italian work, "A Treatise on General and Industrial Organic Chemistry," by Dr. Ettore Molinari. The work of translation has been carried out by Mr. T. H. Pope, of the School of Malting and Brewing of the University of Birmingham.

AN examination of "The Social Guide, 1913," which has now been issued by Messrs. A. and C. Black, at the price of 2s. 6d. net, shows that the editors regard some scientific meetings at least as social events. Attention is directed, for instance, to the meetings of the Royal Society, the Royal Institution, the Royal Geographical Society, and the British Association. The University Extension meetings arranged in the summer by the Universities of Oxford and Cambridge are also referred to, but, speaking generally, the matters of prominence relate to sports and amusements. The subjects are arranged alphabetically, but an index would assist reference greatly.

ERRATUM.—The term $\frac{\Sigma P - P.N}{\frac{N}{2}}$ on p. 279 of NATURE of May 15 should have been $\frac{\Sigma P - P.M}{\frac{N}{2}}$.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR JUNE:—

June 1. 4h. 4m. Venus in conjunction with the Moon (Venus 4° 38′ S.).
,, 12h. 0. Mercury in superior conjunction with the Sun.
4. 0h. 25m. Saturn in conjunction with the Moon (Saturn 6° 22′ S.).
,, 16h. 4m. Mercury in conjunction with the Moon (Mercury 3° 48′ S.).
7. 4h. 40m. Neptune in conjunction with the Moon (Neptune 5° 9′ S.).
19. 14h. 26m. Jupiter in conjunction with the Moon (Jupiter 4° 47′ N.).
June 21. 8h. 8m. Uranus in conjunction with the Moon (Uranus 3° 27′ N.).
,, 13h. 9m. Sun enters Sign of Cancer—summer commences.
22. 6h. 0m. Vesta in conjunction with the Moon (Vesta 0° 31′ N.).
23. 22h. 35m. Mercury in conjunction with Neptune (Mercury 2° 11′ N.).
24. 2h. 0m. Venus at greatest distance from the Sun.
29. 5h. 5m. Mars in conjunction with the Moon (Mars 4° 51′ S.).
30. 7h. 4m. Venus in conjunction with the Moon (Venus 7° 44′ S.).

COMET 1913*a* (SCHAUMASSE).—*Astronomische Nachrichten* No. 4652 contains not only numerous observations of the comet which Mr. Schaumasse discovered, but three sets of elements and ephemerides computed by Kiess and Nicolson, Ebell, and Fayet and Schaumasse. The observations made between May 7 and 11 give the magnitude between 9·5 and 11.

The following parabolic elements are those calculated by the last two observers mentioned above, and they are based on Schaumasse's observations at Nice on May 6, 7, and 8:—

$$T = 1913 \text{ May } 15{\cdot}4222 \text{ M.T. Paris.}$$
$$\left.\begin{aligned}\omega &= 53^\circ\ 32'\ \ 8''\\ \Omega &= 315\ \ 21\ \ \ 7\\ i &= 152\ \ 31\ \ 26\end{aligned}\right\}1913{\cdot}0$$
$$\log q = 0{\cdot}162920$$

Ephemeris for 12*h. M.T. Paris.*

	α (h. m. s.)	δ
May 30	17 45 55	+38 31
June 1	17 15 56	+40 6
,, 3	16 45 33	+41 9
,, 5	16 15 50	+41 35

EFFECTIVE TEMPERATURES OF STARS.—An important communication is published in the *Comptes rendus* of May 5 (vol. clvi., No. 18, p. 1355), by Dr. Charles Nordmann, relative to the effective temperatures of stars. It will be remembered that Dr. Rosenberg published recently (*Astronomische Nachrichten*, No. 4628, p. 360) the results of measures of the effective temperatures of seventy stars based on the determinations of the intensity of the photographic spectra. It will be remembered also that Dr. Nordmann made a like series of measures based, on the other hand, on visual observations. As the two series of measures deal with different regions of the spectrum they may be considered as independent determinations, and Dr. Nordmann here compares the results obtained in cases where the same star has been measured. The following table shows the resulting comparison:—

	Effective temperatures (in absolute degrees)		
	Nordmann λλ 460–630	Rosenberg λλ 400–500	Spectral types (Lockyer)
δ Persei	18500	15500	Algolian
ε ,,	15200	23000	Crucian
β ,, (Algol)	13300	12000	Algolian
α Lyræ (Vega)	12200	22000	Sirian
α Persei	8300	6500	Polarian
α Ursæ Minoris (Polaris)	8200	5200	,,
α Canis Minoris (Procyon)	6800	7000	Procyonian
γ Cygni	5620	5100	Polarian
Sun	5320	4950	Arcturian
α Aurigæ (Capella)	4720	4500	,,
β Andromedæ	3700	2650	Antarian
α Tauri (Aldebaran)	3500	2150	Aldebarian

Dr. Nordmann directs attention to the good agreement of the two series, with one or two exceptions, which he discusses, and points out that if the stars be arranged in the order of ascending temperatures they become hotter and hotter as one passes from the

Aldebarian and Antarian types to helium stars. This, he states, conforms to the thermal classification which Sir Norman Lockyer deduced from his qualitative study of the stellar spectra.

THE WORK OF SIR WILLIAM HUGGINS.—Under this heading, in *The Astrophyical Journal* for April (vol. xxxvii., No. 3) Prof. G. E. Hale takes the opportunity of again cheering up those astronomical observers who possess only a small and limited instrumental equipment, and may conceive the idea that the multiplication of large instruments renders any attempt at research on their part useless. Being the director of an observatory which may be considered the best equipped, contains the largest instruments, and is situated on a nearly ideal mountain site, it may appear that he is only trying to console workers with modest means. But this is not so. Prof. Hale knows the value of both large and small instruments, and there is abundant work for both classes. The reader should look through this article and he will find depicted there the magnificent work of amateurs, in spite of the fact that large instruments were in active employment at the time the work was done. Sir William Huggins he takes as an example of one of "that great English group of amateurs," and he directs attention to the fact that while in 1856 he acquired his first telescope, a 5-in. refractor, in 1858 an 8-in., and in 1870 an 18-in. reflector, such powerful instruments as 15-in. refractors at Pulkowa and Harvard, Lord Rosse's 6-ft. reflector, Lassell's 4-ft. reflector, the Melbourne 4-ft. reflector, &c., did not deter him from securing results of the highest importance.

Prof. Hale concludes in the following terms:—"Every investigator may find useful and inspiring suggestions in the life and example of Sir William Huggins. Their surest message and strongest appeal will be to the amateur with limited instrumental means, and to the man, however situated, who would break new ground."

THE SCOTT EXPEDITION TO THE ANTARCTIC.

THE huge audience which filled the Albert Hall on Wednesday evening, May 21, on the occasion of the Royal Geographical Society's meeting to hear Commander Evans's account of the Scott expedition to the Antarctic, showed no less by its eager plaudits than by its suppression of them at the fitting moments that the public sense of the tragedy of the expedition is not dulled by familiarity. Yet throughout the proceedings there was no false note of sentiment; the president, Lord Curzon, stated, without risk of misunderstanding, that the tribute of the society to the dead had been paid already, and begged any (and there were some) who felt that "this great reception is inconsistent with the feelings of sorrow which affect us all" to "abandon such a reflection," for that he was sure that Scott himself would not have had his companions forgo the reward of their labour. And the story of the expedition was told by Commander Evans very simply; he exhibited the sense of loss which all his collaborators share in a few words only, and by implication rather than by direct statement. Finally, the tribute paid by both president and lecturer to the generosity of the public and to the Government for the provisions made for the dependants of those who are lost showed that any criticism which has been directed against the allowances made from the public funds is without official concurrence.

It was satisfactory to learn that the funds subscribed will admit of the proper publication of the scientific results of the expedition. As regards these results, not a great deal emerged from the lecture which was not already realised by those who have taken interest in this aspect of the work accomplished. Nor was it to be expected that any detail should be given within the compass of a single lecture, though long; for it was long, and a tribute is due to Commander Evans, who so ably sustained the strain of delivering it, and never for a moment allowed the intense interest of the audience to wane. And here a word, though perhaps scarcely appropriate in this place, may be permitted in commendation of the singularly well-chosen organ music which was given before the opening of the proceedings.

But if it is scarcely possible, after hearing the lecture, to add materially to what is already known as to the scientific results of the expedition, it is right at the outset to record the full measure in which the value of those results has clearly been enhanced by photography. Obviously no photographer to any expedition has laboured with a more thorough sense of his duty, or more successfully, than Mr. Ponting. The lecture was delivered with lowered lights and with an accompaniment of lantern slides throughout, and was followed by a few kinematograph films of extraordinary interest. It is impossible to over-praise the beauty of the photographs, nor is it easy to select those of chief scientific interest, though an exquisite series showing new ice at successive stages of formation may be specially mentioned. Of the moving pictures, those of the killer whales were singularly clear, though the motion of creatures of their kind is familiar to many; those which showed seals leaving and entering the water through ice-holes were of even greater interest and value.

Some wonder has been expressed, with the vast area unexplored in the Antarctic region and the many problems awaiting solution in mind, that Scott elected to follow Shackleton's route, or even (and this criticism dates from early Arctic days) that he or anyone else should desire to reach the geographical pole at all. Against this there should be recalled the desire once expressed by a high Antarctic authority, that the south pole should be reached as quickly as possible since, until it should be, explorers would not rest content with work in other directions merely. On this count criticism is scarcely to be directed against Scott's expedition, for it included the largest scientific staff ever taken to the Antarctic, and scientific research certainly played no subordinate part in relation to the journey to the pole. We know already of the devotion with which Scott himself and his lost companions carried their geological specimens to the end of those last dreadful marches. Commander Evans showed how the three weeks during which the ship was held in the pack on the outward voyage were "not wasted," for magnetic observations, soundings, and serial sea temperatures were obtained, while marine biological work of importance was also done. Only the impossibility of finding a suitable base at Cape Crozier prevented the expedition from landing there in order that the embryology of the emperor penguins during winter might be studied. Wilson afterwards made his famous winter expedition thither, and one heard how he recorded the unimaginable temperature of 109° of frost.

Mr. Griffith-Taylor's party, which traversed the Ferrar Glacier, broke new ground, reaching a valley free of snow, containing a fresh-water lake only surface-frozen and full of algæ. Gravels in this limestone region, rich in garnets, "were washed for gold, but only magnetite was found." Commander Evans also paid tribute to Dr. Simpson's work as physicist and meteorologist, which was carried on after his departure by Mr. Wright, who also "made a special study of ice structure and glaciation." Lieut. Campbell's party, in spite of extraordinary hardships, which included wintering away from its base, for which it was not prepared, was very successful in meteorological, magnetic, geological, and surveying work, while the penguins were the object of further study. Commander Evans had time to commend the work of Mr. Griffith-Taylor on the coast of Victoria Land (in geology and surveying), as well as that carried out on the ship, not only in the open ocean, but on the less-known coasts of New Zealand, no more fully than to intimate that each of these departments of the whole great undertaking is worthy of a lecture to itself, which it is to be hoped may be devoted to it.

Finally, reference is due to the results of the determination of the position of the south pole itself, as obtained by Amundsen and by Scott. The latter fixed the exact spot by means of a 4-in. theodolite, "at a point which only differed from Amundsen's reckoning by half a mile," that is to say, "by one scale division on the theodolite, which was graduated to half a minute of arc. Experts in navigation and surveying will always look on this splendidly accurate determination as a fine piece of work, by our own people as well as by the Norwegian explorers."

At the annual meeting of the society on Monday last, in the Theatre, Burlington Gardens, Lady Scott was presented by Earl Curzon with the patron's medal and the special Antarctic medal awarded to her husband in 1904, inclosed in an inscribed silver casket. Mrs. Wilson also received a patron's medal awarded to Dr. E. A. Wilson. To Lieut. Campbell was presented a gold watch as a special award.

THE BRITISH SCIENCE GUILD.

THE seventh annual meeting of the British Science Guild was held at the Mansion House on May 21, the Lord Mayor in the chair. In his opening remarks, the Lord Mayor made sympathetic reference to the aims and work of the guild, which, he said, seeks to further the application of scientific methods to all human endeavour and advocates the adoption of measures for the conservation of natural resources; in other words, its desire is to foster national efficiency. The Right Hon. Sir William Mather was elected president of the guild in succession to Lord Haldane, who has been president since its foundation. The new vice-presidents elected were Lord Sydenham, the Right Hon. the Lord Mayor of London, the Right Hon. Sir John Brunner, Bart., Sir Patrick Manson, and Sir Philip Watts; and other new members added to the executive committee are Mr. Charles Bathurst, M.P., Mr. R. Kaye Gray, Sir Philip Magnus, M.P., and Mr. Robert Mond.

The annual report, which was adopted at the meeting, surveys the activities of the guild in many directions. Reference is made in it to the new Post Office service for the synchronising of clocks—a subject which the guild has done much to promote. Other matters referred to are the final report of the Royal Commission on Tuberculosis, the new horticultural branch of the Board of Agriculture and Fisheries, the conversion of the Sleeping Sickness Bureau into the Tropical Diseases Bureau, the Society for the Promotion of Nature Reserves, and the Royal Commissions and Departmental Committees appointed during the year to deal with subjects with which science has some relationship. All these Commissions and Committees have been announced already in NATURE, but the report of the guild brings them together in a convenient form as a record of official action.

The various committees of the guild continue to do valuable work. The medical and agricultural committees have drawn up a report on the Government's Milk and Dairies Bill. While recognising that the Bill is a very decided advance in the direction of obtaining pure milk, the committees feel that in certain respects stronger and more drastic action should be taken. A note upon the report of the committees appeared in NATURE of May 1 (p. 222).

A report on tide and wave energy, and on the possibility of utilising this form of energy for power purposes, is being drawn up by the committee on the conservation of natural sources of energy; also a report on the utilisation of peat, which occurs in such enormous quantities in some districts in the British Isles and British possessions.

Owing to the declaration of the Government of the intention to bring in a comprehensive scheme to reorganise the educational system of the country, a joint committee of the education committee and the technical education committee, with Sir William Mather as chairman, was appointed to consider the subject. A valuable report has been drafted, which urges that a scientific system of national education demands:—

(1) The duty of local authorities to make such provisions as will promote healthy growth during infancy and throughout school life.

(2) The absolute necessity of manual work and related practical exercises throughout the whole course of school instruction, and also in the training of teachers.

(3) Efficient public elementary schools within the reach of all children, and attendance at school compulsory until the age of fourteen years is reached.

(4) Attendance at continuation schools for at least six hours per week obligatory up to seventeen years of age for all young persons not otherwise receiving suitable education.

(5) Suitable secondary schools available for all who can profit by them and will undertake to complete the full course of instruction.

(6) The institution of school certificates to serve as passports to higher schools or universities, or as testamurs of satisfactory completion of a school course.

(7) Examinations to occupy a secondary place in comparison with school records for the award of certificates, or to qualify for promotion to higher courses of study.

(8) Coordination of technical institutions and faculties of technology in universities in order to prevent overlapping and render specialised types of technological training available to students who have the capacity to profit by them.

(9) Increased grants to universities and other places of higher education for the purposes of ensuring the reduction of fees for all courses and promoting post-graduate research.

(10) The position and condition of service of teachers of every grade to be greatly improved in order to encourage men and women of the highest aptitude and qualifications to devote their lives to the work of teaching and the advancement of knowledge.

(11) Readjustment of the shares of the cost of education borne by the National Exchequer and by local authorities, so that educational progress may be made primarily a national responsibility.

The synchronisation of clocks committee refers to the Government action in connection with the subject, already mentioned. Since the guild took the matter up the Post Office has always viewed the matter sympathetically, and this new departure will, if it be taken up by those exposing public clocks, be of the utmost value. It is hoped that the railway companies, at least in the metropolis, will take advantage of this enterprise on the part of the Postmaster-General. The borough councils have in the past not been very sympathetic, but perhaps, now that the matter will be arranged for them by the Post Office at such a trifling cost, they will adopt a more progressive attitude.

The explosives committee has considered the question of the available sources of nitrates, and the possibility of obtaining them during war; also the feasibility of manufacturing nitrates on a large commercial scale in this country. The committee considers that it is of the utmost importance that nitrates should be manufactured in Great Britain, even if the manufacture is not profitable; it is, however, of opinion that a commercially successful scheme is possible.

In the report of the Canadian committee reference is made to the conservation of natural resources of Canada. A source of great loss to the country is the prevalence of forest fires, and last year the Government spent the sum of 312,500*l*. in protection against this source of loss. The protection of native birds is also referred to. Much useful work has recently been done by the Canadian Waterways Commission, and in connection with this Dr. H. T. Barnes, the hon. secretary of the Canadian committee of the guild, has continued his valuable researches on ice formation in the St. Lawrence. Other subjects dealt with are radium standards, university settlement, prevention of tuberculosis, and free ice for the poor.

Appended to the report are the reports of committees dealing with the Milk and Dairies Bill, the work of the Canadian branch, and on a national system of education. Prof. R. A. Gregory contributes an appendix in which benefactions exceeding 10,000*l*. for the purposes of science and higher education are recorded, and a comparison is made between the incomes of universities and colleges in the United States and that of State-aided universities in Great Britain. From this article it appears that the total receipts of universities in the United States in the year 1910–11 amounted to nearly nineteen million pounds, and the benefactions to four and a half millions. In the same year, the total receipts of those universities and university colleges in Great Britain which participate in the Treasury grant were little more than 600,000*l*. The receipts from fees in England amounted to rather less than 32 per cent. of the total income. The amount received from endowment was about 15 per cent.; the receipts from local authorities 15·6 per cent. The total receipts of all kinds from the Exchequer amounted to 28·5 per cent. of the income.

As regards numbers of students in universities and technological institutions of university standard, comparison is made with Germany. There are twenty-one universities in the German Empire and eleven technical high schools or technical universities having the power to grant degrees. Taking the universities and technical high schools together, the statistics show that in the year 1910–11 they had about 71,000 matriculated students. The total number of full-time day students in the universities and university colleges of England and Wales (including those of Oxford and Cambridge) in 1910–11 was about 17,000, and in Scotland about 7600, in comparison with 55,000 in German universities. In the technical institutions of the United Kingdom, the number of day students in attendance was about 2000, in comparison with 16,000 in the technical high schools of Germany. From other tables given in the article it appears that more than 90 per cent. of the pupils in the State-aided secondary schools of England and Wales are under sixteen years of age, and one-quarter of the pupils are under twelve years of age. More than four-fifths of the pupils have not passed an examination of university matriculation standard when they leave school. Two per cent. of the pupils proceed to universities, and 7 per cent. to technical schools and institutions, medical schools, training colleges for secondary-school teachers, and like places providing special training for professions, trades, or commercial occupations.

RECENT WORK IN ECONOMIC ENTOMOLOGY.

VALUABLE memoirs published by the Entomological Division of the United States Department of Agriculture are constantly reaching us. Of these, Bulletin 110, on "The Spring Grain-Aphis, or Greenbug," by F. M. Webster and W. J. Phillips, is of more than passing interest. The species described—*Toxoptera graminum*, Rondani—has been noticed as seriously destructive to wheat and other cereals in North America—especially in the Middle Western States—during several seasons from 1890. In the eastern hemisphere it has been recorded only from a few localities—Italy, Hungary, Belgium, India, South and East Africa. The bulletin, extended to 150 pages, gives a full account of the insect, its embryology, post-natal development, habits, and natural enemies. An interesting bionomical observation is that south of the 35th parallel the species reproduces itself only by successive generations of virgin females, and even further to the north the sexual generation may be omitted from the life-cycle in mild winters.

Another bulletin which contains welcome original contributions to our knowledge of the life-history of Hemiptera is No. 108, on "Leafhoppers affecting Cereals, Grasses, and Forage Crops," by Prof. Herbert Osborn. H. M. Russell's contribution (No. 118) on the bean thrips (*Heliothrips fasciatus*) is also noteworthy. It is needless to add that these bulletins all deal with practical means for the extermination or control of the pests.

As a contribution to animal parasitology, Bulletin 106, "The Life-history and Bionomics of some North American Ticks," by W. A. Hooker, F. C. Bishopp, and H. P. Wood, is worthy of mention. It forms an excellent introduction to the ticks of pathological importance, giving diagnostic characters of genera and species, and furnishing in each case details of the early stages in the life-history.

From the Canadian Department of Agriculture we have received Dr. C. Gordon Hewitt's Bulletin, No. 10, on the large larch sawfly (*Nematus Erichsonii*). This paper gives, in a handy form, particulars of the prevalence of the insect as a larch-destroyer in Europe and North America. British entomologists are familiar with Dr. Hewitt's work in connection with this insect in the Cumbrian lake district. He finds it still more injurious across the Atlantic, where, he believes, it must be regarded as an introduced species. Naturally he is endeavouring to acclimatise in Canada the ichneumon-fly (*Mesoleius tenthredinis*), which reduced so considerably the sawfly population on the shores of Thirlmere.

Dr. Hewitt has found time also to contribute to *Parasitology* (vol. v., No. 3, 1912), a short account of the larvæ and bionomics of *Fannia canicularis* and *F. scalaris* (better known to most naturalists under the generic name of Homalomyia). These curious spinose maggots have an unpleasant interest as occasional inhabitants of the human intestinal and urinary tracts.

From the Imperial Indian Government's Agricultural Research Station at Pusa has been issued Bulletin No. 28 on "The Cultivation of Lac in the Plains of India," by C. S. Misra, a well-illustrated account of the insect (*Tachardia lacca*), the trees on which it thrives, their culture, the collection of the product, the manufacture of shellac, and its economic uses. The most dangerous enemies of the lac insect appear to be the predaceous caterpillars of four species of moth.

FORESTS AND CLIMATE.

THE very general belief in the influence of forests upon climate, and especially upon rainfall, is discussed by Prof. R. de Courcy Ward in an interesting article in the April number of *The Popular Science Monthly*. The subject is very complicated, and the author points out that we must be careful not to put the cart before the horse; in other words, the forests are the result of the rainfall, and not *vice versâ*.

The various questions involved are discussed in detail, the following being among the points dealt with:—(1) The historical method; (2) why forests should influence climate; (3) influence upon (*a*) temperature, (*b*) humidity and evaporation; (4) the cases frequently cited as showing an influence upon rainfall; (5) recent European studies. Among the authorities quoted, Hellmann has shown that the increase in the rainfall over a forest is accompanied by a lessened fall to leeward—simply a slight difference in distribution. Both Voeikof (Russia) and Hann (the leading authority on climate) believe that the vast tropical forests may increase the amount of rainfall. But as regards our own latitudes the author considers that there is at present no conclusive evidence that forests have a significant effect upon the amount of rain*fall*, as distinguished from the amount of the rain*catch* in the gauge.

There is comparatively little popular interest in the possible influence of forests upon temperature; the forest is a little cooler than the open in summer, and possibly very slightly warmer in winter. Supan sums up the case as follows:—"No one will care to maintain that the system of isotherms would be radically altered if Europe and Asia were one great forest from ocean to ocean." With regard to moisture, the author thinks that the local supply from forests cannot play any considerable part in the great rain-producing processes.

SYSTEMS OF LONG-DISTANCE WIRELESS TELEGRAPHY.

THE Advisory Committee appointed by the Postmaster-General to consider and report on the merits of existing systems of long-distance wireless telegraphy has made its report. The Committee heard evidence in private from representatives of the Marconi, the Telefunken, the Poulsen, the Goldschmidt, and the Galetti interests, and of the Admiralty, and the members visited a number of stations.

The report is strictly limited to practical considerations, and deals with matters of engineering rather than of scientific interest. From the point of view of the building of stations for immediate operation in the Imperial wireless chain, the report is overwhelmingly in favour of the Marconi Company, not only on account of its plant, but also on account of its experience; though the Committee points out that it would be possible for the Government to get together a highly trained staff and erect the stations, using any desirable patents under the provisions of section 29 of the Patents and Designs Act, 1907. The Marconi spark plant was tested by the Committee as to duplex working, and as to automatic transmission at the rate of sixty words per minute, across the Atlantic, a distance of 2300 miles. The Committee found Transatlantic communication practically continuous, though there are periods when the signals become very weak; and there are occasional periods when no signals at all can get through. These weak periods are due to natural causes, and can probably only be overcome by the use of high powers.

The Committee received no evidence supporting the reported transmission from San Francisco to Honolulu (2100 miles) by the Poulsen arc, but witnessed transmission over a relatively short distance at seventy words per minute. The members also saw the Goldschmidt alternator transmit at the rate of sixty words per minute. It is interesting to note that the Marconi Company and the Telefunken Company are both experimenting with generators of continuous waves. The Marconi machine consists essentially of a rapidly rotating contact-maker in a direct-current circuit with special dispositions of other circuits to give continuous oscillations in the antenna. The Telefunken machine is an alternator constructed to give as high a fundamental frequency as may be convenient in the first instance, the frequency being doubled or quadrupled by a polarised transformer method. The Marconi machine was witnessed working across the Atlantic.

SOME FURTHER APPLICATIONS OF THE METHOD OF POSITIVE RAYS.[1]

THE method to which I shall refer this evening is the one I described in a lecture I gave here two years ago. The nature of the method may be understood from the diagram given in Fig. 1. A is a vessel containing the gases at a very low pressure; an electric discharge is sent through these gases, passing from the anode to the kathode C. The positively electrified particles move with great velocity towards the kathode; some of them pass through a small hole in the centre, and emerge on the other side as a fine pencil of positively electrified particles.

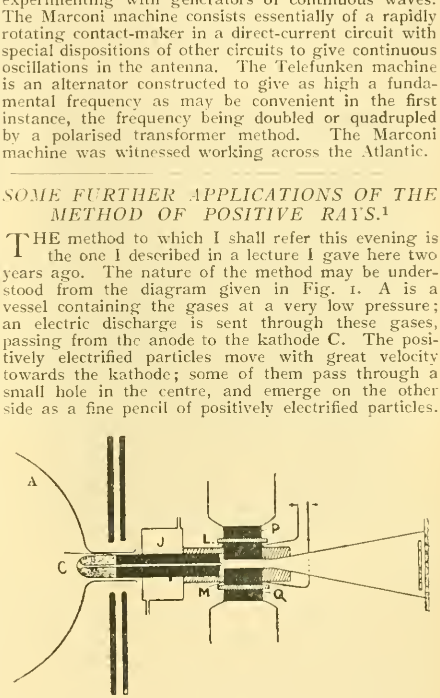

Fig. 1.

This pencil is acted on by electric forces when it passes between the plates L and M, which are connected with the terminals of a battery of storage cells, and by a magnetic force when it passes between P and Q, which are the poles of an electromagnet. In the pencil before it passed under the influence of these forces there might be many kinds of atoms or molecules, some heavy, others light, some moving quickly, others comparatively slowly, but these would all be mixed up together. When they are acted on by the electric and magnetic forces, however, they get sorted out, and instead of travelling along the

[1] Discourse delivered at the Royal Institution on Friday, January 17, by Sir J. J. Thomson, O.M., F.R.S.

same path they branch off into different directions. No two particles will travel along the same path unless they have the same mass as well as the same velocity; so that if we know the path of the particle we can determine both its mass and its velocity. In chemical analyses we are concerned more with the mass than with the velocity, and we naturally ask what is the connection between the paths of particles which have the same mass but move with different velocities. The answer is that all such paths lie on the surface of a cone, and that each kind of particle has its own cone; there is one cone for hydrogen, another for oxygen, and so on. Thus one cone is sacred to hydrogen, and if it exists there must be hydrogen in the vessel; so that if we can detect the different cones produced from the original pencil, we know at once the gases that are in the tube. Now, there are several ways of identifying these cones, but I shall only refer to the one I have used in the experiments I wish to bring before you this evening. These moving electrified particles, when they strike against a photographic plate, make an impression on the plate, and a record of the place where they struck

FIG. 2.

the plate can be obtained. Thus, when a plate is placed in the way of the particles streaming along these cones, the sections of these cones by the plate (parabolas) are recorded on the photograph, hence we can identify these cones by the parabolic curves recorded on the photograph, and these parabolas will tell us what gases are in the vessel.

The first application of the method which I shall bring before you this evening is to detect the rare gases in the atmosphere. Sir James Dewar kindly supplied me with two samples of gases obtained from the residues of liquid air; the samples had been treated so that one might be expected to contain the heavier gases, the other the lighter ones. I will take the heavier gases first. The photograph of these is shown in Fig. 2. When the plate is measured up it shows a faint line corresponding to the atomic weight 128 (xenon), a very strong line corresponding to the atomic weight 82 (krypton), a strong argon line 40 (argon), and the neon line 20. There are no lines unaccounted for, and hence we may conclude that in the atmosphere there are no unknown gases of large atomic weight occurring in quantities comparable with those of xenon or krypton. This result gives an example of the convenience of the method, for a single photograph of the positive rays reveals at a glance the gases in the tube. I now turn to the photograph of the lighter constituents shown in Fig. 3; here we find the lines of helium, of neon (very strong), of argon, and, in addition, there is a line corresponding to an atomic weight 22, which cannot be identified with the line due to any known gas. I thought at first that this line, since its atomic weight is one-half that of CO_2, must be due to a carbonic acid molecule with a double charge of electricity, and on some of the plates a faint line at 44 could be detected. On passing the gas slowly through tubes immersed in liquid air the line at 44 completely disappeared, while the brightness of the one at 22 was not affected.

The origin of this line presents many points of interest; there are no known gaseous compounds of any of the recognised elements which have this molecular weight. Again, if we accept Mendeléef's periodic law, there is no room for a new element

FIG. 3.

with this atomic weight. The fact that this line is bright in the sample when the neon line is extraordinarily bright, and invisible in the other when the neon is comparatively feeble, suggests that it may possibly be a compound of neon and hydrogen, NeH_2, though no direct evidence of the combination of these inert gases has hitherto been found. I have two photographs of the discharge through helium in which there is a strong line, 6, which could be explained by the compound HeH_2, but, as I have never again been able to get these lines, I do not wish to lay much stress on this point. There is, however, the possibility that we may be interpreting Mendeléef's law too rigidly, and that in the neighbourhood of the atomic weight of neon there may be a group of two or more elements with similar properties, just as in another part of the table we have the group iron, nickel, and cobalt. From the relative intensities of the 22 line and the neon line we may conclude that the quantity of the gas giving the 22 line is only a small fraction of the quantity of neon.

Let me direct your attention again to the photograph of the heavier gases in the atmosphere. You will notice that the parabolas corresponding to many of the elements start from points which are all in the same vertical line; this indicates that the atoms or molecules which form these parabolas all carry the same charge. Several of these lines, however, do not follow this rule; you will notice, for example, that the neon line has a prolongation which comes nearer than the normal line to the vertical line drawn through the undeflected spot. Measurement of the photograph shows that the neon line begins at a distance from this vertical line which is only half the normal distance; this shows that some of the neon atoms in the positive rings possess two charges of electricity; the majority of them, however, only possess one. If you examine the argon line you will find that it comes even nearer to the vertical than the neon line; in fact, it begins at a distance from the vertical only one-third of the normal distance; this proves that the argon atom can have as many as three charges of electricity. If now you examine the krypton line you will find that it comes nearer to the vertical line than even the argon; its least distance is one-fourth of the normal distance, showing that the krypton atom may have as many as four charges. The mercury line comes so close to the vertical line that it is only on large photographs that it can be seen that there is in reality an interval; this interval is only one-eighth of the normal interval, showing that mercury may acquire eight positive charges, *i.e.* that it may lose eight corpuscles. The mercury atom when it is on this line must have only the normal charge, *i.e.* it must have regained all but one of the corpuscles it previously lost; if it had retained two positive charges it would have been on the line corresponding to the atomic weight 200/2 or 100; if it had retained 3, or 4, 5, 6, 7, 8 on the lines corresponding to the atomic weights, 200/3, 200/4, 200/5, 200/6, 200/7, 200/8 respectively. All these except the last have been detected on the plate. The lines corresponding to the multiple charges on krypton, argon, and neon have also been detected. It appears, then, that in a vacuum tube a mercury atom, for example, may be ionised in two ways; in the one way the atom loses one corpuscle, in the other it loses eight.

I would suggest that these two types of ionisation may result from the two different types of collision which the atom must experience. The first type is collision with a corpuscle; since the corpuscle is an exceedingly small body moving with a very great velocity, it can pass freely through the atom, and the collision it makes with the atom is really a collision with a corpuscle inside the atom; this may result in the corpuscle it strikes acquiring such a great velocity that it is able to escape from the atom; this type of collision will result in the detachment of a single corpuscle. The second type of collision is when the atom collides with another atom and not with another corpuscle; the result of this collision may be that the atom suffers a sudden change in its velocity. This change is not at first shared by the corpuscles, so that these just after the collision may have a very considerable velocity relative to the atom. If there are several corpuscles which are comparatively loosely attached to the atom, these may all be detached from it and leave it with a positive charge corresponding to the number shaken out. It is this type of collision which we regard as giving the multiply-charged ions, and we see that the magnitude of the charge is a measure of the number of corpuscles in an atom which are readily detachable from it. We have seen that the greater the atomic weight the greater the charge it can acquire, the maximum charge being roughly proportioned to the square root of the atomic weight, hence the heavy elements have a larger number of detachable corpuscles than the lighter ones.

Another application of the method I should like to bring before you is the use of it for the discovery and investigation of a new substance. I have in previous lectures said that sometimes there appeared on the plates a line corresponding to a particle with an atomic weight 3; this must either be a new element or a polymeric modification of hydrogen, represented by H_3. The other possibility that it is a carbon atom with four charges is put out of court by the fact that it frequently occurs when the carbon line is exceedingly faint, and when there is not a trace of a carbon atom with even two charges, though the doubly-charged carbon atom occurs readily under certain conditions. In addition to this, the carbon atom parabola never approaches the vertical near enough to allow of its having four charges. I thought the study of the substance producing this line would be of interest, and I have for some time been working at it, and although the research is by no means completed, I have obtained some results which I should like to bring before you.

At first I was greatly hindered by not knowing the conditions under which the line occurred; although it appeared from time to time on the plates, its appearance was always fortuitous and sometimes for weeks together the plates would not show a trace of the line. The line sometimes appeared, but why it did so was a mystery, and I could not get it when I wanted it. I began an investigation, which proved long and tedious, to find the conditions under which the line appeared. I tried filling the discharge-vessel with all the gases and vapours described in the books on chemistry without success. At last I tried bombarding various substances with kathode rays. Under this treatment the substances give off considerable quantities of gas the greater part of which is hydrogen, carbonic acid, or carbon monoxide. When I came to analyse by the positive rays the gases given off in this way, I found that with a large number of substances these gases contained the substances giving the three lines, so that I was now in a position to get this line whenever I wanted it, and investigate the properties of the gas to which it owes its origin. The question of the gases absorbed and given off by solids is an extremely interesting one, and a considerable number of investigations have been made on it. In all these, so far as I know, the method has been to heat the solid to a high temperature, and then measure and analyse the very considerable amount of gas which is driven off by the heating. So far as I know, no experiments have been made in which the gases were driven off by bombardment with kathode rays. This treatment, however, will cause the emission of gas even when ordinary heating fails to do so.

Belloc, who has recently published[2] some interesting experiments on this subject, after spending about six months in a fruitless attempt to get a piece of iron in a state in which it would no longer give off gas when heated, came to the conclusion that, for practical purposes, a piece of iron must be regarded as an inexhaustible reservoir of gas. There are some interesting features about the emission of gas from a heated solid. If the body is kept for a long time in a vacuum at a high temperature, the emission of gas becomes too small to be detected; if after this treatment the temperature is raised considerably, there will be a further copious emission of gas, which again diminishes as the heating continues. After it has fallen to zero, all that is necessary is to raise the temperature again and you will get a fresh supply of gas; and so far as my experience goes, after you

[2] *Ann. de Chimie et de Physique* [8], xviii., p. 569.

have got all the gas you can out of the solid by heating it, you have only to expose it to kathode rays to get a fresh outburst. This effect of increased temperature in renewing the stream of gas from the solid seems to me to be too large to be accounted for merely by an increase in the rate of diffusion of the absorbed gas from the interior to the surface; it seems to be more analogous to the case of the emission of the water of crystallisation from some salts. There are some salts, for example, copper sulphate, which when heated lose their water of crystallisation in stages; thus, if the temperature is raised to a certain value, some of the water of crystallisation comes off, but the rest remains fixed, and you may keep the salt at this temperature for ever without getting rid of all the water of crystallisation; on raising the temperature, however, fresh water of crystallisation is given off. Something of this kind seems to take place in the case of gases absorbed in metals, and there seem to be indications that there is some kind of chemical combination between the gas and the metal. This absorbed gas may influence the behaviour of the substance. For example, an ordinary carbon filament gives off, when raised to a white heat, large quantities

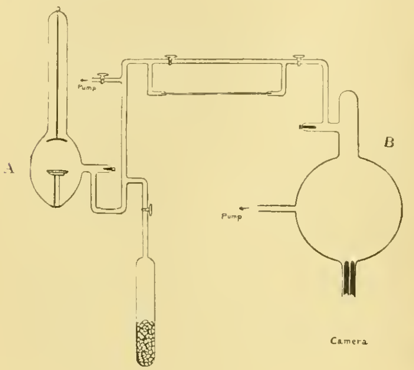

FIG. 4.

of negatively electrified corpuscles; but Pring and Parker[3] have shown that when great precautions are taken to get rid of the absorbed gas, the emission of these corpuscles falls to less than one-millionth of their previous value. It is in the gases given off by certain metals when they are bombarded by kathode rays that I have found an unfailing source of the substance, which I shall denote by X_3, giving the line corresponding to the atomic weight 3. The arrangement I have used for investigating the presence of this gas is shown in Fig. 4. A is a vessel communicating with the bulb B in which the positive rays are produced by two tubes, one of which is a very fine capillary tube, while the other one is five or six millimetres in diameter; taps are inserted so that one or both of these vessels can be closed, and the vessels A and B isolated from each other. A is provided with a curved kathode such as are used for Röntgen ray focus tubes, and the kathode rays focus on the platform on which the substance to be bombarded is placed. (It is not absolutely necessary to focus the kathode rays in this way, but it makes the supply of the gas X_3 more copious.) After the metal or other solid to be examined has been placed on the platform, the taps between A and B being turned so as to cut off the connection between them, A is exhausted until the vacuum is low enough to give the kathode rays; the discharge is then sent through A, and the kathode rays bombard the solid. The result of this is that in a few seconds so much gas, mainly CO_2 and hydrogen, is driven out of it that the pressure gets too high for the kathode rays to be formed, and unless some precautions to lower the pressure were taken the bombardment would stop. To avoid this, a tube containing charcoal cooled by liquid air is connected with A, and this absorbs the CO_2 and enough of the hydrogen to keep the vacuum in the kathode ray state. To see what new gases are given off in consequence of the bombardment, a photograph is taken while the connection between A and B is cut off. After this is finished, and when the bombardment has gone on for about four hours, the tap is turned and a little of the gas from A is allowed to go into B; another photograph is taken, and those lines in the second photograph which are not in the first represent those gases which are liberated by the bombardment, and have escaped being absorbed by the charcoal. I have here a slide (Fig. 5) representing the result of bombarding nickel. There are two photographs, one

α FIG. 5. β

(α) before turning the tap, and the other (β) after; in the second you see the 3 line very distinctly, while it is absent from the first, showing that the gas giving the 3 line has been liberated by the bombardment. I have got similar results to these when, instead of nickel, iron, copper, lead, and zinc have been bombarded. I have tried two specimens of meteorites kindly lent to me from the Mineralogical Museum, Cambridge, and found there the 3 line. Nearly every substance I have tried gives, the first time it is bombarded, the helium line as well as this line due to X_3; if, however, the same substance is bombarded a second time, the helium line is in general absent (occasionally it is still to be detected, though exceedingly faint); and on the third bombardment is invisible in all the substances I have tried except monazite sand, where it is given off in exceedingly large quantities so long as the bombardment continues. It is remarkable that monazite sand, which contains so many elements, gives no trace of the 3 line when bombarded.

I have also obtained the X_3 line and also the helium line when the tube A was replaced by one containing a Wehnelt kathode; with this the current of kathode rays through the tube was much larger than with the other kathode, though the velocity of the rays was

[3] *Phil. Mag.*, xxiii., p. 192.

smaller. The Wehnelt kathode gives the line without placing pieces of metal in the tube, so that in this case nothing is bombarded by the kathode rays but the glass walls of the tube; the strip of metal forming the kathode is, however, bombarded by the positive rays.

The 3 line when present at all continues even though the bombardment is very prolonged. In some cases the bombardment has been prolonged for twenty hours, and at the end of that time the line seemed almost as bright as at the beginning; indeed, I could not feel certain that there was any difference. This might lead one to suspect that X_3 was manufactured from the lead or other metal by the bombardment rather than stored up in it, and this view might be regarded as receiving some support from the fact that very little of the X_3 is liberated by heating. The following experiment is an illustration of this. I took a piece of lead, and instead of bombarding it with kathode rays I placed it in a quartz tube connected with vessel A, and heated the tube to a bright red-heat for several hours. Large quantities of CO, and hydrogen were driven off by this process; this was absorbed by charcoal, and the residual gases, which had accumulated in A, were admitted into the vessel B; the X_3 line and helium line could just be detected, and that was all. I then gave the lead a second heating, raising this time the temperature until the quartz was on the point of softening. The lead was boiling vigorously; the heating was kept up for about three hours. In this time about three-quarters of the lead had boiled away. I then let the gases which had been given off at the second heating into the vessel B, and took another photograph; no trace of the line due to X_3 or helium could be detected. The fraction of the lead which had not been boiled away was now placed in A and bombarded by kathode rays. It now gave the 3 line quite distinctly; the helium line was visible, but faint. By the bombardment with the kathode rays the lead was only just melted, so that the average temperature was much less than when it was heated in the quartz tube. This rather suggests that the X_3 might be due to a kind of dissociation of the metal by the kathode rays, and not to a liberation of a store of that substance. Another experiment shows, however, that for lead, at any rate, this view is not tenable. I took some lead which had just been deposited from a solution of lead acetate by putting a piece of zinc into the solution, and forming the well-known lead-tree. When I bombarded this freshly precipitated lead, I could get no trace of the X_3 line; the helium line, too, was absent. I then tried another experiment. I took a piece of lead and divided it into two parts. The first of these I bombarded by the kathode rays: it gave the X_3 line quite distinctly. The other part I dissolved in boiling nitric acid, getting lead nitrate. The nitrate was heated and converted into oxide, and this was bombarded by the kathode rays: it did not give the X_3 line, showing that the X_3 is not produced by the bombardment, but is something stored up in the lead, which can be detached from it when the lead is dissolved. I have tried several samples of lead; the one which gave the X_3 line most distinctly was a piece of lead from the roof of Trinity College Chapel, several hundred years old. A sample of Kahlbaum's chemically pure lead, which must, I suppose, at no distant date have been subjected to severe ordeals by fire and water, showed the line quite distinctly, though not so well as the older lead. I have tried similar experiments with iron, and found that iron which gave the 3 line very distinctly ceased to do so after it had been dissolved in acid.

As the most obvious explanation of X_3 is that it is H_3, bearing the same relation to hydrogen that ozone does to oxygen, and produced in some way from the hydrogen dissolved in the metal, I tried if I could produce it by charging metals with large quantities of hydrogen, and then seeing if the hydrogen coming from the metal gave any traces of H_3. Thus, for example, I tested the hydrogen given off from hot palladium, but found no trace of X_3. I then charged nickel at a temperature of about 355° C. with hydrogen in the way recommended by Sabatier, but found no increase in the brightness of the X_3 over nickel that had not been deliberately exposed to hydrogen. I tried if the brightness of the line would be increased by adding hydrogen to the bulb A, in which the bombardment took place, but found no effect. I also tried adding oxygen to this bulb, thinking that if it was H_3 it would combine with the oxygen, and thus be eliminated, but no great diminution in the intensity was produced by this treatment. The gas seems quite stable, at least it can be kept for several days without suffering any diminution that can be detected; indeed, when once it has got into a bulb, there is considerable difficulty in getting the bulb free from it. It must be remembered, too, that by the method by which it is produced the gas is subjected all the time to electric discharges which would break it up unless it possesses very great stability. Thus if X_3 is a polymeric modification of hydrogen, it must possess the following properties:—

(1) It must be very stable.

(2) it must resist the action of oxygen.

(3) It must not be decomposed by long-continued exposure to the electric discharge.

These are properties which *a priori* we should scarcely have expected an allotropic modification of hydrogen to possess.

Mendeléef predicted the existence of an element with an atomic weight 3. According to him this element should be intensely electro-negative and possess the properties of fluorine to an exaggerated extent. The gas X_3 can, however, be kept in glass vessels, which we should not expect to be possible if it possessed more than fluorine's power of combining with glass. I prefer to defer expressing any opinion as to the actual nature of the gas until I have had the opportunity of making further experiments upon it. It is only about two months ago that I found how to get the gas with any certainty, and, as the method involves long bombardments, each experiment takes a considerable time. This has prevented me from making several experiments which suggest themselves, and which ought to be made before coming to a final decision. I thought, however, that the investigation, though incomplete, might not be unsuitable for a Friday evening discourse, as the gas, whatever its nature, is certainly one of considerable interest, and its detection illustrates the delicacy of this new method.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Sudbury-Hardyman prize offered for an original dissertation by a graduate member of Emmanuel College under the standing of M.A. has been increased to 40*l*., and divided between G. E. K. Braunholtz, formerly scholar and research student, and R. D. Vernon, research student. Mr. Braunholtz's dissertation was "The Nomina of Italy, peculiar to Gallia Transpadana," and Mr. Vernon's "The Geology and Palæontology of the Warwickshire Coalfield."

THE electors to the Michael Foster research studentship in physiology give notice that there will be an election to the studentship in the year 1913. Candidates are required to send in their applications to the professor of physiology before the end of June, with a statement of the course of research which they propose to undertake.

The Board of Agricultural Studies, in consultation with the president of the Royal Agricultural Society, has nominated C. R. Fay to be the Gilbey lecturer on the history and economics of agriculture.

The General Board of Studies is authorised to appoint a University lecturer in agricultural physiology for a further period of five years from midsummer, 1913. The lecturer will receive an annual stipend of 200*l*., payable out of the agricultural education fund.

Leeds.—Mr. W. A. Millard, formerly assistant lecturer in botany, has been appointed lecturer in agricultural botany.

A series of week-end lectures on modern Germany will commence on May 31, and will be continued on June 6, 7, and 14. Among the lecturers will be Dr. Hiby, managing director of the Otto Coke Oven Co., on industrial and social conditions; Prof. Smithells, on the story of German science; and Mr. J. L. Paton, on modern German education.

Manchester.—The council has made a number of appointments and rearrangements in the department of chemistry consequent on the resignation of Prof. W. H. Perkin on his acceptance of the chair of chemistry at Oxford. Dr. A. Lapworth, F.R.S., has been appointed professor of organic chemistry and Dr. Charles Weizmann has been appointed reader in biochemistry and lecturer in colouring matters. Dr. E. C. Edgar and Dr. F. B. Burt have been made senior lecturers in chemistry. Prof. H. B. Dixon has been reappointed director of the chemical laboratories, to supervise the department as a whole.

Mr. Edward Sandeman has been appointed associate professor of engineering in the University. He will lecture on water supply and irrigation, and will be responsible for the studies of all students specialising in this branch of engineering.

Oxford.—The fourth Halley lecture was delivered in the schools on May 22 by Dr. Louis A. Bauer, director of the department of research in terrestrial magnetism in the Carnegie Institution of Washington, U.S.A. The subject of the lecture was "The Earth's Magnetism." Dr. Bauer paid a tribute to Halley as one of the greatest among early investigators of the variations of the compass. He described the two years' cruise undertaken by Halley in the years 1698–1700, at the cost of William III., for the purpose of making magnetic observations. The expedition which left New York four years ago in the *Carnegie* had followed the same track, but found a great alteration in the magnetic conditions. The magnetic poles were gradually shifting. Though Halley's theory of terrestrial magnetism was not strictly correct, it seems to have been the first definite recognition of the complexity of the problem. This would not be completely solved until the physicists were able to answer the question, What is magnetism?

A valuable lecture on wireless telegraphy has been given before the Ashmolean Society by Mr. W. G. Gill, of the Officers Training Corps and fellow of Merton College.

Entries for the Final Honour School in Natural Science number eighty-nine, distributed as follows:—Physics, ten; chemistry, thirty-two; zoology, two; physiology, eighteen; botany, five; geology, ten; engineering science, twelve.

On May 27 Congregation passed the preambles of two statutes relating to the holders of professorships at present tenable for life, and to which no canonry is annexed. The statutes provide that every such professor shall vacate office within one year of attaining the age of seventy years, and that a scheme of pensions shall be established to apply to professors vacating office under the above conditions. If these statutes are finally adopted in their present form, they will not apply to any of the present holders of professorships, nor, in all probability, to any of their successors for some years to come. It has, however, been widely felt that some steps should now be taken to provide for the eventual establishment of a satisfactory system of retirement and pension, nothing of the kind being at present in existence.

The University of Glasgow has received, under the will of Miss Jeanie Pollock, of Glasgow, the sum of 10,000*l*. for providing a materia medica research lectureship.

Dr. George Barger has been appointed by the Senate of the University of London to the University chair of chemistry tenable at the Royal Holloway College, with the status of appointed teacher.

Dr. S. B. Schryver, biochemist at the Research Institute of the Cancer Hospital, Brompton Road, S.W., has been appointed assistant professor of biochemistry at the Imperial College of Science and Technology.

The board of regents of the University of Nebraska recently voted a general increase in the salaries of deans and professors in the University. *Science* states that the necessary 7000*l*. was obtained from the additional maintenance grant voted by the last legislature.

Dr. L. F. Guttmann, formerly of London University and the College of the City of New York, and for the last four years assistant professor of physical and industrial chemistry at Queen's University, Kingston, Canada, has been appointed associate professor of chemical engineering in this University.

It is now announced that the executors of the late Sir J. Wernher, Bart., have completed the allocation of the 100,000*l*. bequeathed to them to be devoted to charitable and educational purposes. 35,000*l*. has been allotted to charitable and educational purposes in South Africa, and the balance of 65,000*l*. has been distributed over nearly 150 different institutions in this country. Among the grants for scientific and educational purposes may be mentioned: to the Institute of Mining and Metallurgy, 5000*l*.; the Imperial Service College, Windsor (to found a scholarship for Bedfordshire), 2500*l*.; the London School of Tropical Medicine, 1500*l*.; and lesser amounts to the London School of Economics, the Bedford College for Women, and the Working Men's College.

SOCIETIES AND ACADEMIES.

London.

Geological Society, May 7.—Dr. Aubrey Strahan, president, and afterwards Mr. W. Whitaker, in the chair.—M. **Odling**: The Bathonian rocks of the Oxford district. The lithology, palæontology, and stratigraphy of the Bathonian rocks north of Oxford are described, from the evidence afforded by numerous quarries and well-borings and by the Ardley Cutting. The general sequence is given. After a general account of the series, the points of interest in the sections and their relations are described; and it is pointed out that, although no definite zones can be formulated, the different horizons are recognisable by their assemblage of fossils. The chemical and microscopic structures of the rocks are dealt with, and the conditions of deposition and stratigraphical relationship of the different members of the series discussed. Some structures from the Chipping-Norton Limestone are described, and the reasons given for considering them to be annelid-tubes. A list of fossils is appended.—Dr. J. A. **Thomson**: The petrology of the Kalgoorlie Goldfield (Western Australia). The district comprises an area about four miles long by one mile in breadth. Towards the south the auriferous lodes are rich (The Golden Mile), but in the north they are less productive. Most of the junctions are faulted. In "The Golden Mile" the central feature is a broad dyke of quartz-dolerite, forming a prominent ridge flanked by amphibolites and greenstones. The quartz-dolerite is cut by dykes of albite-porphyry. Gold is found in shear-zones, impregnated with sulphides and tellurides, and is most abundant in the lodes in the quartz-dolerite. The sequence of the rocks of Kalgoorlie is discussed. The greenstones, fine amphibolites, and calc-schists are regarded as the old "country-rocks," into which the others are intrusive. The quartz-dolerites, hornblende-dolerites, and pyroxenites are closely related one to the other. Probably the peridotite group is the early basic facies of the quartz-dolerite series, and the porphyries and porphyrites are regarded as being derived from the same magma. The characteristic of this goldfield is the prevalence of albitisation in the auriferous districts. A consideration of the rock-facies developed from the magma suggests that there is in Kalgoorlie an instance of the production of auriferous lodes by rocks belonging to the same class as the pillow-lavas and their diabases and soda-granite-porphyries.

PARIS.

Academy of Sciences, May 19.—M. F. Guyon in the chair.—A. **Haller** and Edouard **Bauer**: Monomethylcamphoroxime, methylcampholenic nitrile, and methylcampholenic acid. By the action of sodium amide and methyl iodide upon camphor, a mixture of monomethylcamphor and dimethylcamphor is obtained. These can be separated by treatment with Crismer's salt (hydroxylamine chlorozincate); dimethylcamphor remains unchanged, and can be separated from monomethylcamphoroxime by fractional distillation.—M. de **Forcrand**: The condition of water in hydrated salts. The determination of the heat of solution of hydrated salts is suggested as the best means of attacking the problem of the condition of the attached water molecules.—M. André **Blondel** was elected a member of the section of free academicians in the place of the late Louis Cailletet.—H. **Godard**: Observations of the comet 1913*a* (Schaumasse) made with the 38-cm. equatorial at the Observatory of Bordeaux. Two positions are given for May 16. The comet appeared as a diffuse nebulosity, without nucleus, of 10·5 magnitude.—J. **Guillaume**: Observations of the Schaumasse comet (1913*a*) made with the equatorial of the Observatory of Lyons. Two positions are given for May 10 and one for May 11. The comet is described as circular, bluish, condensed at the centre; magnitude about 10·5.—Rodolphe **Soreau**: A new approximate formula for the length of the ellipse.—Paul **Lévy**: The integration of functional partial differential equations.—M. **Moulin**: The law of deformation of the flat spiral spring of chronometers.—M. de **Sparre**: Hammering of the water in pipes formed of sections of different diameter.—C. **Tissot**: The influence of electrical oscillations on the conductivity of certain fused metallic salts. A layer of certain fused salts (lead and thallium chlorides, cadmium bromide, silver nitrate, chloride, and bromide) in contact with two metallic plates as electrodes becomes conducting when the E.M.F. exceeds a certain limiting value. If the system is now submitted to electrical oscillations of sufficient intensity, the conductivity immediately disappears.—Carl **Benedicks**: The deduction of Planck's law of distribution of energy by the hypothesis of agglomeration. Planck's law can be deduced without the use of the *quanta* hypothesis.—J. **Chaudier**: The variations of magnetic rotatory power in changes of state.—André **Léauté**: The precautions to be taken in the use of resonance in tests of electric cables intended for use with high voltages.—R. V. **Picou**: Internally excited dynamos.—Camille **Matignon**: The law of volatility in chemical reactions. The law of Berthollet is given in a generalised form. Any system of solids or non-volatile liquids susceptible of giving rise by a new grouping of atoms to a system containing volatile bodies ought to enter into reaction at a suitable temperature. Thus it has been shown that at a very high temperature aluminium will react with magnesia, the magnesium formed being gaseous. The reduction of barium oxide by silicon is another example.—G. **Arrivaut**: Study of the system manganese-silver. Manganese and silver are capable of forming the combination $MnAg_2$; experimental evidence on this is given dealing with the melting-point curves, microscopical structure, electromotive forces, and chemical behaviour of various alloys of the two metals. This conclusion is opposed to that previously arrived at by G. Hindrichs.—Marcel **Gompel** and Victor **Henri**: The quantitative study of the absorption of the ultra-violet rays by the alkaloids of the atropine group. Absorption data are given for atropine, apoatropine, and cocaine.—MM. **Taffanel** and Le **Floch**: The combustion of gaseous mixtures. An examination of the causes of the lag in the inflammation of combustible mixtures of methane. Moisture was found to be without effect in reducing this lag.—J. **Aloy** and Ch. **Rabaut**: Benzoyl cyanhydrins of ketones, amides, and the alcohol acids from which they are derived.—E. E. **Blaise**: The characterisation of the chloro-ketones. The use of the semicarbazones was found to be advantageous for the identification of the chloro-ketones.—Alfred **Guillemard**: Nature of the optimum osmotic pressure in biological processes.—Jean **Daniel**: The relations existing between the age of the dicotyledons and the number of successive layers of their secondary woods. Under certain conditions of growth the number of concentric layers of secondary wood cannot be distinguished, and the number of years of growth cannot be determined by this means.—C. J. **Pitard**: The vegetation of Chouia, Morocco.—M. **Hirtz**: Intensive galvanotherapy with feeble current density.—Louis **Roule**: Contribution to the study of the biology of the salmon.—L. **Bordas**: A case of lateral budding in *Lumbricus herculeus*.—J. **Bounhiol**: The reproduction of the Algerian sardine.—Albert **Berthelot**: Researches on the intestinal flora. The pathogenic action of a microbial association of *Proteus vulgaris* and *Bacillus aminophilus*. A study of the symbiosis of these two organisms *in vitro* leads to the conclusion that the *B. aminophilus* prevented to some extent the growth of Proteus, but experiments *in vivo* with white rats at once showed that the opposite was the case. Proteus alone, even in large doses, is without apparent influence on rats, but in association with the bacillus above-mentioned, enteritis is rapidly produced.—G. **Béchamp**: Concerning *microzyma cretae*. Remarks on a recent communication by Raphaël Dubois.—J. **Lesage**: Epizootic myocarditis of the sheep.—C. **Gerber**: Comparison of the hydrolysing diastases of the latex of *Maclura aurantiaca* with those of *Ficus carica* and of *Broussonetia papyrifera*.—J. **Vallot**: The value and variation of the temperature of the lower portion of the glacier of Mont Blanc.

BOOKS RECEIVED.

Fortschritte der naturwissenschaftlichen Forschung. Edited by Prof. E. Abderhalden. Achter Band. Pp. 308. (Berlin and Vienna: Urban and Schwarzenberg.) 15 marks.

Behaviour Monographs. Vol. ii., No. 1, Serial No. 6. The Delayed Reaction in Animals and Children. By W. S. Hunter. Pp. 86. (Cambridge, Mass.: H. Holt and Co.)

Cape of Good Hope. Department of Mines. Sixteenth Annual Report of the Geological Commission. 1911. Pp. 136+v. (Cape Town: *Cape Times*, Ltd.)

A Naturalist in Cannibal Land. By A. S. Meek. Edited by F. Fox. Pp. xviii+238+plates. (London: T. Fisher Unwin.) 10s. 6d. net.

The Living Plant. By Prof. W. F. Ganong. Pp. xii+478+plates. (New York: H. Holt and Co.) 3.50 dollars net.

The Child: its Care, Diet, and Common Ills. By Dr. E. M. Sill. Pp. viii+207. (New York: H. Holt and Co.) 1 dollar net.

The Fringe of the East. By H. C. Lukach. Pp. xiii+273. (London: Macmillan and Co., Ltd.) 12s. net.

Trans-Himalaya. By Sven Hedin. Vol. iii. Pp. xv+426+plates+maps. (London: Macmillan and Co., Ltd.) 15s. net.

A Dictionary of Applied Chemistry. By Sir E. Thorpe, assisted by eminent contributors. Revised and enlarged edition in five vols. Vol. iv. Pp. viii+727. (London: Longmans and Co.) 45s. net.

Ueber kausale und konditionale Weltanschauung und deren Stellung zur Entwicklungsmechanik. By W. Roux. Pp. 66. (Leipzig: W. Engelmann.) 1.50 marks.

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. Lief. 34. (Jena: G. Fischer.) 5 marks.

DIARY OF SOCIETIES.

THURSDAY, MAY 29.

ROYAL SOCIETY, at 4.30.—*Acineta tuberosa*; a Study on the Action of Surface Tension in Determining the Distribution of Salts in Living Matter: Prof. A. B. Macallum.—Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. IV. The Mzimba Strain: Surg.-General Sir David Bruce, Major D. Harvey, Major A. E. Hamerton, and Lady Bruce.—Notes on *Toxoplasma gondii*: Helen L. M. Pixell.—An Investigation by Pedigree Breeding into the Polymorphism of *Papilio polytes*, Linn.: J. C. F. Fryer.—The Action of Radium Rays upon the Cells of Jensen's Rat Sarcoma: Dr. S. Russ and Dr. Helen Chambers.

ROYAL INSTITUTION, at 3.—Recent Chemical Advances. II. Chemistry in Space: Prof. W. J. Pope.

ROYAL SOCIETY OF ARTS, at 4.30.—Indian Section.—Irrigation Works in India: Sir John Benton, K.C.I.E.

SOCIETY OF DYERS AND COLOURISTS, at 8.—The Action of Ozone on Some Textile Fibres: Dr. C. Dorée.—Some Defects in Silk Dyeing: Dr. L. L. Lloyd.

FRIDAY, MAY 30.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting. At 8.30.—Practical Application of Telephone Transmission Calculations: A. J. Aldridge

PHYSICAL SOCIETY, at 5.—The Origin of New Stars: Prof. A. W. Bickerton.—Electro-thermal Phenomena at the Contract of Two Conductors with a Theory of a Class of Radio-telegraph Detectors: Dr. W. H. Eccles.—The Evaluation of Certain Combinations of the Ber, Bei, and Allied Functions: S. Butterworth.—The Extraordinary Ray Resulting from the Internal Reflection of an Extraordinary Ray at the Surface of an Uniaxal Crystal: J. Walker.

SATURDAY, MAY 31.

ROYAL INSTITUTION, at 3.—Radioactivity. II. The Origin of the Beta and Gamma Rays and the Connection between them: Prof. E. Rutherford.

MONDAY, JUNE 2.

ROYAL INSTITUTION, at 3.—The Heredity of Sex and Some Cognate Problems: Prof. W. Bateson.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Precipitation in Aqueous and Colloidal Systems: W. P. Dreaper.—Some Experiments on the Theory of Electro Tanning: E. K. Rideal and U. R. Evans.—An Illustration of the Partial Pyrite Process: W. R. Schoeller.—The Estimation of Alcohol in Beer by Means of Malligand's Ebullioscope: J. C. Cain.—The Joint Action of Catalysing Agents. Dehydration of Ethyl Alcohol and Ethyl Ether: General W. Spatiew.

INSTITUTE OF ACTUARIES, at 5.

TUESDAY, JUNE 3.

ROYAL INSTITUTION, at 3.—Recent Advances in the Production and Utilisation of Wheat in England: Prof. T. B. Wood.

ZOOLOGICAL SOCIETY, at 8.30.—Notes on Turacin and Turacin-bearers: Sir A. H. Church.—Observations on the Anatomy of the Shoe-bill (*Balaeniceps rex*): Dr. P. Chalmers Mitchell.—Some Miocene Cirripedes of the Genera Hexelasma and Scalpellum from New Zealand: T. H. Withers.—The Classification and Phylogeny of the Calcareous Sponges, with a Reference List of all the Described Species, systematically arranged: Prof. A. Dendy and R. W. H. Row.—Contributions to the Anatomy of the Ophidia: Surg. J. C. Thompson.—Observations on Osteomalacia in the Zoological Collections of Manchester and Cleveland: Prof. T. Wingate Todd.

RÖNTGEN SOCIETY, at 8.15.—Reflection of X-rays: Prof. C. G. Barkla.—Experiments on the Reflection of X-rays: Dr. R. W. A. Salmond.

WEDNESDAY, JUNE 4.

SOCIETY OF PUBLIC ANALYSTS, at 8.—An Electrochemical Indicator for Oxidisers: E. K. Rideal and U. R. Evans.—The Estimation of Tannin in Tea: H. L. Smith.—The Detection and Estimation of Nickel by means of α-Benzildioxime: F. W. Atack.—The Analysis of Various East Indian Tanned Hides: M. C. Lamb.—Note on the Sterilisation of Rag Flock Samples: L. Reed.—A General Method for the Detection of Caramel: P. F. Thompson.

ROYAL INSTITUTION, at 3.—The Heredity of Sex and Some Cognate Problems. II.: Prof. W. Bateson.

THURSDAY, JUNE 5.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Origin of Mammals: Dr R. Broom.

ROYAL INSTITUTION, at 3.—Recent Chemical Advances. III. The Structure of Crystals: Prof. W. J. Pope.

FRIDAY, JUNE 6.

ROYAL INSTITUTION, at 9.—Reflection and Refraction of Light as Concealing and Revealing Factors in Sub-aquatic Life: F. Ward.

SATURDAY, JUNE 7.

ROYAL INSTITUTION, at 3.—Radio-activity. III. The Radio-active State of the Earth and Atmosphere: Prof. E. Rutherford. (The Tyndall Lectures.)

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Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, JUNE 5, 1913.

DYNAMICS OF GOLF.

The Soul of Golf. By P. A. Vaile. Pp. xiii+356. (London: Macmillan and Co., Ltd., 1912.) Price 6s. net.

THIS is a breezy, well-written book, full of valuable hints to the ambitious golfer. Much of the instruction takes the form of attack upon the writings of other exponents, and this makes lively reading. With a great deal of the criticism most golfers who have tried to formulate the principles of the game will agree. But it is not human to be perfect, and Mr. Vaile does not escape falling into pitfalls himself, especially when dealing with the dynamical aspect of things. To the November number of *The Fortnightly Review* he contributed an article on the dynamics of golf, in which he seems to regard himself as a supreme authority. In one respect this article is an improvement on the book, for he accepts in its simplicity Newton's explanation of the swerve of the spinning ball advancing in air, and in one paragraph gives quite a good account of this phenomenon, very much as Tait did years ago. Unfortunately he obscures the explanation in a later paragraph when he says that it is "the continual friction on the lower portion of the ball which gradually forces it up."

Mr. Vaile is merciless in his exposure of looseness of language. Yet in his discussion of the value of furrows cut on the face of iron clubs (a method, by the way, first adopted by Tait), he writes that "marking is frequently done by great deep lines, and, particularly in the mashie, nearly always by lines which run from heel to toe. Now in the great majority of mashie shots, when one is putting on cut one requires lines running in an exactly opposite direction"—that is, if English means anything, from toe to heel! Mr. Vaile, of course, does not mean that, any more than Sir J. J. Thomson means that the golf-ball is spinning like a sleeping top when he says that slicing and pulling are due to rotation about a vertical axis. Sir J. J. Thomson does not say that this is the only spin that exists; but it is the component of spin about the vertical axis which has to do with the phenomena of slicing and pulling. When the ball is rotating about an axis not truly horizontal, there must be a component about a vertical axis. This component, regarded from above, will be either right-handed or left-handed, according to circumstances, producing respectively slicing or pulling. This, obviously, is the meaning to be attached to Sir J. J. Thomson's words. In his article Mr. Vaile says: "Prof. Thomson must now realise that if the axis of spin was the same in each ball"—that is, each sliced or pulled ball—"their conduct on landing would be similar." Can Mr. Vaile not imagine that though the axis of spin may be the same, the direction of rotation about the axis may be either the one way or the other?

Mr. Vaile is to be congratulated upon the clear way in which he describes the conditions under which the so-called "push-shot" with cleek or iron is obtained. But the main feature of this stroke was well understood on the golf-links of St. Andrews and Musselburgh long before the days of Varden or Vaile. The divots of turf which were removed by the club after it hit the ball proved incontestably that this particular stroke of club on ball occurred during the descent of the club. In his article on long driving in *The Badminton Magazine* of March, 1896, the late Prof. Tait shows clearly how underspin is produced. In his figures on p. 370, Tait represents the velocity of the clubhead at impact by the line AB, and remarks that "AB may be made to take any direction we please—*i.e.* the clubhead may be represented as moving in any direction whatever; but it *is quite sufficient for our purpose*[1] to treat it as moving horizontally." Mr. Vaile regards this sentence as meaning that Tait considered every well-driven ball as being projected by a horizontal blow; for he deliberately says that a "fundamental error" of the late Prof. Tait consisted "in regarding the blow of a golf-club as being a force directed in a line parallel with the horizon." This is really very bad. Yet there is a worse case of unpardonable carelessness in Mr. Vaile's reading of the *Badminton* article.

In a footnote on p. 380 of this article Tait, with the honesty of the real investigator, points out the difficulties under which his "laboratory experiments" on the *velocity of projection* of a golf-ball were made, and Mr. Vaile quotes this footnote as if it referred to a totally different experiment described on p. 381. The latter experiment, with one end of a long, untwisted tape "tied to the ball and the other to the ground," was clearly not made in the laboratory at all. The ball was driven into a stiff clay face, not into the 10-inch disc of clay spoken of in the footnote; and the difficulties of aim did not enter into the experiment with the tape. Tait always found the tape twisted in such a way as to show underspin. Mr. Vaile will not believe it. He should therefore try the experiment himself instead of criticising what he has not taken the trouble to understand aright. By this experiment Tait proved to the simplest intellect that underspin was invariably present in

[1] The italics are ours.

a well-struck ball. But before the experiment was thought of Tait had proved to the mind capable of understanding the dynamics of golf that it is not possible to obtain the *distance* of flight and the *time* of flight by balls projected with *permissible* velocities at the *small angles of elevation* which characterise well-driven balls, unless an uplifting force comes into play.

Mr. Vaile is neither fair to Tait nor true to fact. In his chapter x. he says, quite untruly—for the dates can easily be given [2]—that Tait did not take underspin into consideration until after a great drive by which his son Freddie proved that the father's calculations were wrong. He then proceeds to point out what he thinks are errors in Tait's article in *The Badminton Magazine*, which has been already referred to. For example, Tait's remark that "the existence of rotation is manifested at once by the strange effects it produces on the curvature of the path" is branded "as incorrect from a scientific point of view," and "also badly stated." What follows on p. 225 of "The Soul of Golf" shows that our author has not grasped the scientific significance of the problem. He says that it is well known to all golfers that the spin begins to work as the velocity of the ball decreases, and then makes the astounding statement that "it is incorrect to refer to the strange effects it (rotation) produces on the curvature of the path, for it is the rotation itself which produces the curvature."

If this means anything other than Tait meant, it means that the parabola described by a projectile *in vacuo* has no curvature, nor has the path described in air by a ball devoid of rotation. Gravity apparently is not in it! Mr. Vaile fails to see that Tait is comparing the path of a rotating golf-ball with the path it would have had if no rotation had existed. The real dynamic truth is that the underspin begins to work from the very beginning of the drive. The curvature of the path is influenced *from the start*, as witness the upward concavity of the wind-cheater. Not only so, but the underspin exerts its greatest influence at the beginning of the drive when the spin and the velocity are both at their greatest. When Mr. Vaile asserts that it is in the second part of the trajectory that the back-spin is exerting its greatest influence, he is confusing what the eye seems to see with what has been really taking place. The ordinary golfer, indeed, is quite ignorant of what any particular path would have been had there been no spin; also he is badly placed to see the real form of the path, and the initial velocity is too great for him to follow the early details of the flight. Tait's calculated curves bring out the form of the wind-cheater beautifully (see NATURE, June 29, 1893). These calculations are based on the combined effect of gravity and the upward force due to coexistence of translation and spin. Both these motions are present from the beginning, and must dynamically assert themselves from the start. To speak of pace, when there is enough of it, as beating spin, is nonsense. Spin alone has no lifting or swerving power. It must coexist with translational velocity; and the lifting power increases with the amounts of both.[3] The particular instant at which the eye recognises the accumulated effect of the upward lift proves nothing as to the manner in which this lifting force has gone through its successive values. The idea that the spin asserts itself only after the ball has travelled a considerable part of the trajectory is dynamically grotesque and hopelessly erroneous.

The flight of the golf-ball is not a problem which can be solved by intuition; and the man who has not mastered Tait's papers on the path of a rotating spherical projectile is not in a position to criticise Tait's conclusions. If Mr. Vaile will take the trouble to turn up the first of these papers he will find pictured a theoretical curve the gradually increasing curvature of which as the linear speed of the projectile falls off will reveal to him all the essential characteristics of the path of the sliced ball. He may then possibly understand the truth which Tait was wont to impress upon his students year by year, that the direct evidence of our senses is frequently misleading unless controlled and corrected by reason.

There are several other statements in Mr. Vaile's account of the flight of the golf-ball which are scientifically unsound. Thus, on p. 244 he says that the club

"is nearly always moving either upwards or downwards in a curve at the moment it strikes the ball, so that it stands to reason, especially when the club-face is travelling upwards, which is what it does in the great majority of cases, that the blow is never delivered horizontally, but is always struck more or less upward through the ball's centre of mass."

This is deliciously loose, for it means grammatically that when the club-face is travelling either upwards or downwards it strikes the ball upward through the centre of mass. Of course, Mr. Vaile does not mean to say so. What he seems to mean to assert is that in the *great majority of cases* the impulse is through the centre of mass of the ball. If that were so, there could be no underspin, nor, indeed, any spin at all. The great majority of

[2] See, for example, "A Golf Myth: Prof. Tait's Alleged Error," in *Golf Illustrated*, January 1, 1909; or in my "Life and Scientific Work of P. G. Tait," pp. 26-28.

[3] See, for example, Lord Rayleigh, "On the Irregular Flight of a Tennis Ball," *Messenger of Mathematics*, 1877; "Scientific Papers," vol. i.

strokes would be unaccompanied by the phenomena of slicing or pulling or rising above the natural gravitational path. The dynamical condition for the production of underspin is clearly pointed out by Tait in his various articles. The resultant blow must be delivered so as to act in a line which passes beneath the centre of mass. For this purpose the blow need not be horizontal; but a horizontal stroke with a lofted club will produce underspin if the club-face hits the ball below the height of the centre. In this sense loft is an important factor in the production of underspin. In all cases, whether the ball is hit with a downward or a practically horizontal stroke, the production of underspin depends on the existence of a pronounced tangential component of impulse, and this requires that the direction of the blow must be inclined to the face of the club.

Mr. Vaile expresses the same idea when he speaks of the ball being hit with a glancing blow. In his explanation of the manner in which the wind-cheater is produced he is indeed quite sound; and it is a matter of regret that a book so admirable in many respects should be marred, not only by faulty dynamics, but by an inability to follow the dynamical reasoning of a master like Tait. Mr. Vaile sneers at the mathematician and physicist as having gone on utterly fallacious lines. He misquotes, and when he quotes aright he not unfrequently misunderstands. Nevertheless, on the more practical aspects of the game, when he is speaking for himself, and not piling up adjectives of denunciation against the mathematician, Mr. Vaile has done no small service in removing some of the clouds of mystery with which popular writers have obscured the soul of golf.

C. G. KNOTT.

THE AGE OF THE EARTH.

The Age of the Earth. By A. Holmes. Pp. xii+196. (London and New York: Harper and Brothers, 1913.) Price 2*s*. 6*d*. net.

THE question "For how long has it been possible for organic beings to have lived on the earth?" must always be one of supreme interest; and it is good to find a book which states shortly but quite clearly how far we have proceeded towards an answer.

No great weight ought ever to have been given to the argument from the lengthening of the day, because it assumes that the ratio of the polar and equatorial diameters of the earth now is the same as when the earth ceased to be liquid; in spite of the fact that great forces are acting tending to change this ratio. Kelvin's argument from the temperature gradient downwards in the earth's crust ceased to be of value when it was shown that greater conductivity in the interior led to an enormously larger answer; for whether such greater conductivity is or is not probable, it could not be said to be impossible. We are sorry that Mr. Holmes should refer to the work of Mr. Clarence King as if it affected the question. He, following Kelvin, assumed that there could be no greater conductivity inside the earth than in the crust. But all earth-cooling arguments have been set aside by Mr. Strutt's measurement of radium in rocks, and they are now of historical interest only.

Three of the old arguments still hold the field—one from the sun's energy, a second from the amount of salt in the oceans, and the third from observations of rates of erosion and deposit of sediment. To these a fourth is now being added which is likely to have great weight in settling the matter—the increase in the proportion of lead to uranium in rocks as time goes on. Mr. Holmes has himself devoted much time to the laboratory study of radio-active minerals, and of the creation of lead and helium from uranium; in the present state of our knowledge we can suggest no modification of his figures. He ought, however, we think, to be prepared to accept a less age for the earliest sedimentary rocks than 1300 million years.

Consideration of the amount of sodium in the ocean gives less than a quarter of this age, as does also the consideration of the accumulation of carbonate of lime. These two methods of study are on a much less certain basis than the calculation from the rate of accumulation of sediment, which, however, gives about the same age. With this last method Mr. Holmes, as a geologist, is very familiar. The suggestion that erosion used to take place more slowly because all continents were smaller and lower in level than now, would lead to a better agreement between the two methods which he favours. If the average slopes were 60 per cent. of what they are now, we are led to multiply the age by four. On the whole, we feel with Mr. Holmes that the question is in a fair way towards settlement, but, unlike him, we still see a difficulty due to the age of the sun. A person who has not made the calculation will scarcely believe in the liberality with which Kelvin treated his opponents in regard to the argument based on the sun's heat. Assuming that the whole mass of the sun was once scattered through space, and by mere gravitation the stuff came together as we now have it, and considering that it is denser in its central part, the total amount of energy given out as heat cannot be much greater than 25 million times the amount of heat now given out in one year. Kelvin, after making this kind of calculation, said: "It seems, therefore, on the whole, most probable that the sun has not illuminated the earth for 100 million years, and almost certain that he has not done so for 500 million years."

The possibility that the existence of radium in the sun might increase the calculated age has been carefully considered, and it is found that it will not do so; it has no practical effect on the result if the proportion of radium to other substances is taken to be the same as it is on the earth.

It may have been the possibility of a much less radiation from the sun in the past that caused Kelvin to be so generous. But, making every allowance of this kind, it is difficult to imagine a greater age than 100 million years; indeed, it is difficult to imagine so great an age. It seems absolutely necessary to find more energy than mere gravitational energy, and we are very loth to assume that the matter which now forms the sun had once much greater atomic energy than it possesses now. It is curious that the mathematics of a spherical mass of gas, published in NATURE, July 13, 1899, pp. 250 and 252, should lead to a speculation of this very kind; that is, that the mass of gas could not exist unless there was originally some more atomic energy than we find it to possess in the laboratory. Lord Kelvin thought that this conclusion merely meant that such a body would collapse until its stuff ceased to behave as a perfect gas. In these days when the facts of radio-activity are unsettling our beliefs, and it is necessary to get the sun's heat argument into agreement with the others, there is a temptation to let our thoughts linger on the other speculation, although, indeed, it must be quite absurd. And yet we know that the second law of thermodynamics is being evaded somewhere in the universe.

Our thanks are due to Mr. Holmes for this very welcome and interesting little book. J. P.

POPULAR BOTANY AND GARDENING.

(1) *Trees and How They Grow*. By G. Clarke Nuttall. With 15 Autochromes by H. Essenhigh Corke. Pp. xi + 184 + plates. (London: Cassell and Co., Ltd., 1913.) Price 6*s*. net.

(2) *Wild Flowers as They Grow*. Photographed in Colour Direct from Nature by H. Essenhigh Corke. With Descriptive Text by G. Clarke Nuttall. Fifth Series. Pp. viii + 200. (London: Cassell and Co., Ltd., 1913.) Price 5*s*. net.

(3) *Garden Flowers as They Grow*. Photographed in Colour Direct from Nature by H. Essenhigh-Corke. With Descriptive Text by H. H. Thomas. Pp. iii + 197. (London: Cassell and Co., Ltd., 1913.) Price 5*s*. net.

(4) *Garden Work: A Practical Manual of School Gardening*. By William Good. Pp. xvi + 399 + plates. (London: Blackie and Son, Ltd., 1913.) Price 3*s*. 6*d*. net.

(5) *Dahlias*. By George Gordon. Pp. xi + 115 + 8 coloured plates. (London and Edinburgh: T. C. and E. C. Jack.) Price 1*s*. 6*d*. net. (Present-Day Gardening.)

IT is somewhat difficult to know just what to say about the majority of the numerous popular works on botany and gardening that are turned out in such rapid succession in these days —in some cases the writers of such books rival even the most popular of popular novelists in their industry, turning out half-a-dozen or more sizeable books a year. If one is to judge them critically, one is bound to say that these books are, on the whole, rather poor; if inclined to cynicism, one would certainly say that most of them are totally unnecessary; but, after all, one cannot but rejoice at the increasing interest in plant-life and gardening of which this flood of good, bad, and indifferent books may be regarded as the outcome and reflection. One may at least admit that compilers of books of this kind are making fairly good use of improved methods of colour and other illustration processes; that the letterpress, though too often hasty and slipshod, is freer from actual inaccuracies than one might have expected; and that these books are likely to arouse the reader's interest. So much to the good; only, since the writing of such books appears to be fatally easy, let us hope that some few readers may resist the temptation to write books themselves.

(1) This is a readable and interesting account of a number of common trees, with fifteen coloured plates by Mr. Corke, in addition to which the author contributes a large number of remarkably good photographs, including stages in the germination of the seeds and the unfolding of the buds in the majority of the trees dealt with. So much has been done in the letterpress to make the story of these trees attractive that it seems a pity the author did not give, either as introduction or appendix, a general account of the growth of trees and the many interesting biological features (leaf-mosaics, for instance) which they present, and perhaps some account of the ecology of woodlands as developed in Britain—to mention only one or two of the aspects of tree-life not touched upon.

(2) Messrs. Nuttall and Corke are steadily working their way through the British flora; in this volume the former describes, and the latter depicts, a fifth batch of twenty-five native wild flowers. The coloured plates are unusually good, even for

this series; practically all the colours are as true to life as present processes of reproduction can make them, and one can scarcely select any for special praise, though the pictures of butterbur, dwarf thistle, corncockle, and teasel are perhaps among the most pleasing. The line-drawings in the text are still rather too diagrammatic and poorly executed, as in previous volumes. On the other hand, the descriptions show great improvement, the author having incorporated in his accounts the results of quite recent observations on the biology of both flowers and vegetative organs—as an instance of the latter we may mention his account of recent experiments on the biological significance of the water-pitchers of the teasel.

(3) Here the same indefatigable illustrator contributes twenty coloured plates to what is probably the first volume of a companion series of picture-books on garden flowers. It is not easy to see for what class of reader a book of this kind is intended, though the text is pleasingly written, and the pictures nice to look through—one is tempted to suggest that this sort of book is simply meant to be laid on the parlour table for the delectation of the waiting visitor, as a change from the old-fashioned album or book of views. The practical gardener has surely no use for books like this, and the text is not such as to be of much service to the amateur grower. Still, there seems to be a brisk demand for any and every sort of book on botany or gardening that is illustrated in colour and attractively got up in a "suitable-for-presentation" style, and we may leave it at that.

(4) This is another book which scarcely appears to fill a distinct gap in the copious literature of gardening. The author is enthusiastic and practical, but the botanical portions of the book (chapters iii. and iv.) are rather badly in need of revision, and some of the illustrations are poor woodcuts which contrast strangely with the many excellent photographs; some of these cuts (*e.g.* those on pp. 48, 162, 170, 171, 174, 226, and 241) would be well-nigh unrecognisable if not labelled. Since this book is published at a low price, and may come into sufficient demand to make a second edition necessary, it is to be hoped that it will be subjected to considerable revision; apart from the unsatisfactory blocks just referred to, at least half of the illustrations given are neither necessary nor helpful as aids to the comprehension of the letterpress, and might well be omitted, or replaced by more useful pictures. It is only just to add that, apart from the more botanical portions, the text is thoroughly practical and clear, and the book would form a very useful guide to the amateur gardener, as well as to the school-teacher, for whom it is more particularly intended.

One thing that certainly ought to be omitted from a new edition is the preface, the writer of which appears entirely to have overlooked the danger of advising the turning loose of troops of school-children armed with trowels and collecting-tins—what this has to do with school-gardening is hard to see—to help in the extermination of rare plants. It would have been much more to the point to have directed attention to the urgent need for the protection of wild plants against the avarice of collectors old enough to know better, rather than to deplore the fact that the vasculum and fern-trowel are not yet ubiquitous in this country. We have quite enough plant-collectors as it is, though we could do with more students of plant-life in field and garden—that is quite another thing.

(5) The editor of the "Present-Day Gardening" series, which is rapidly becoming an invaluable library in itself, is to be congratulated on having secured for the authorship of the volume on dahlias the president of the National Dahlia Society. Needless to say, Mr. Gordon has succeeded in giving, within comparatively small compass, an immense amount of information of all kinds about these flowers, including an extremely interesting historical chapter and the thoroughly practical hints regarding cultivation that might be expected from a writer of authority upon the subject. The eight coloured plates by Mr. Waltham are well chosen and beautiful. It may seem somewhat ungracious to find fault with such a fine series as this, but the pasteboard binding is very liable to get cracked in use, and one cannot help wishing that more resistant material had been used in covering the books. F. Cavers.

OUR BOOKSHELF.

Wild Life. An Illustrated Monthly. Vol. i., Nos. 1–5. Edited by Douglas English. (London: *Wild Life* Publishing Co., 1913.)

Last summer the members of the Zoological Photographic Club held an exhibition at the offices of the Zoological Society, and the object of this periodical is to continue and extend the work of that exhibition. The first number appeared in January and promised well. Mr. R. B. Lodge wrote of eagles and vultures in Albania, and Mr. Farren, who showed some wonderfully beautiful photographs, described the life of the egrets in the valley of the Guadalquivir, where Mr. Abel Chapman and Mr. Buck have done so much to preserve this species. Mr. Francis Ward had some interesting notes and plates of fishes, living birds, and otters: the photographs were taken in his pond on a method of his own invention.

The editor's paper on the sand-wasp (*Odynerus spinipes*) was welcome as breaking new ground in photography, for of photographs of birds it is possible to get weary, unless they have something new to tell us; and that is by no means always the case, in spite of the editor's extravagant claim (p. 8) that our knowledge of British birds has been doubled in the last decade by photography alone.

We are glad to see that in the four succeeding numbers the art is applied freely to insects and reptiles, as well as to birds and quadrupeds. The March number contains some admirable photos of the three species of British snakes, and also a good paper on the snake-fly and the alder-fly, with illustrations showing a decided improvement on those of the sand-wasps. The April number has a paper with good illustrations of young moles, and the May number is appropriately devoted mainly to the cuckoo. Special mention may be made of Mr. Oliver Pike's "bioscope record" of the performance of a young cuckoo in ejecting from the nest a sedge-warbler older and larger than itself. We wish the editor and his contributors all success in their work, hoping at the same time that, in spite of the beauty of its illustrations, *Wild Life* will not be used by beginners simply as a picture-book.

Photographic Supplement to Stanford's Geological Atlas of Great Britain and Ireland. Arranged and edited by H. B. Woodward, F.R.S., with the cooperation of Miss Hilda D. Sharpe. Pp. 113. (London: Edward Stanford, Ltd., 1913.) Price 4*s*. net.

Two years ago Miss Hilda Sharpe published a field notebook of geological illustrations (see NATURE, vol. lxxxviii., p. 74), and she has now done further service by collecting nearly half the photographs in Mr. H. B. Woodward's volume. Some of the remaining half have been previously published by the Geological Survey, and others are from the series in the care of the British Association. Among the most original and suggestive are Miss Sharpe's own "View from Summit of Caer Caradoc," showing the outweathered cones of Uriconian rock, and Mr. Armstrong's "Escarpment of Millstone Grit, near Leek." Landscapes like these, and the Survey's "Raised Beaches near Strome Ferry," illustrate the geological atlas better than any number of quarry-sections. Among the latter, however, the Jurassic Clay and Limestone at Bromham (No. 68) and the Chalk and Thanet Sand at Crayford (No. 89) are highly characteristic. The Scotch views include the Torridon Sandstone and the mountainous features near Glen Etive; but the wild heart of Skye is unrepresented. Ireland is honoured by one picture, a rather distant view of the Giant's Causeway; but should this very compact basaltic lava be called a dolerite?

We are glad to see Mr. H. Preston's work in England well utilised, as in the cases of the Norwich Crag of Thorpe (No. 97) and the massive limestones of Lincolnshire; but such a book always makes us ask for more. Those who use the atlas will look for further help in realising the country. Can we not have the cirques of Snowdon, the long lakes of Westmoreland, white between their rain-swept hills, the highland border beyond Stirling, or the scarp of the intrusive sheet that fixed the margin of the Roman world? G. A. J. C.

A Dictionary of English and Folk-Names of British Birds. By H. Kirke Swann. Pp. xii+266. (London: Witherby and Co., 1913.) Price 10*s*. net.

THIS book is strictly a dictionary, and on that account less interesting to turn over than Mr. Swainson's "Provincial Names of Birds," published for the English Dialect Society in 1886, which also dealt to some extent with the folklore. Mr. Swann, however, claims to have added some three thousand names to those collected by his predecessor: he has evidently taken great pains, and deserves much credit for a handbook which will always be useful. We will make one critical remark only. If Welsh, Gaelic, Cornish, and Irish names are freely admitted to the list, why not Anglo-Saxon, which are at the roots of our own local names? "Enid," for example, was the English word for a duck till the fifteenth century, but it is not here. Mr. Swann's work begins with Chaucer; but he might well search the Anglo-Saxon vocabularies for addenda to a second edition.

Religious Beliefs of Scientists: Including over 140 hitherto Unpublished Letters on Science and Religion from Eminent Men of Science. By A. H. Tabrum. With an Introduction by Rev. C. L. Drawbridge. New and enlarged edition. Pp. xxi+309. (London: Hunter and Longhurst, 1913.) Price 2*s*. 6*d*. net.

To the second edition of this collection of letters forty new communications, which Mr. Tabrum has received in reply to his questions from workers in science, have been added. Such a compilation of opinions must necessarily be of doubtful value, the questions propounded unavoidably lack precision, and the answers too often turn out to be very general in character. But the volume will be of interest to the class of reader who is anxious to know the opinions of distinguished men on important questions outside their own special fields of knowledge.

The British Empire with its World Setting. By J. B. Reynolds. Pp. viii+200. (London: Adam and Charles Black, 1913.) Price 1*s*. 4*d*.

THE attempt to survey the geography of the British Empire in a little book of this size, at the same time providing an outline sketch of the geography of the rest of the world and upwards of ninety maps, diagrams, and illustrations, more than forty of them being full-page pictures, was bound to lead to very severe compression. The number of place-names on a single page is often far greater than children can be expected reasonably to remember. The book is very attractive in appearance, and the writer's name is a guarantee for accuracy.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

A Plea for Uniformity in Radio-active Nomenclature.

IN a letter to NATURE (vol. lxxvi., p. 661, 1907) Prof. Rutherford advised against an immediate adoption of a permanent system of nomenclature for the radio-elements since the discovery of a new element in the midst of a series would entail the alteration of the names of a possible half-dozen others which follow it. It was considered, however, that the number of products still to be discovered was nearly exhausted, and that when there was a general consensus of opinion that such was the case, chemists and physicists should meet together in order to revise the whole system of nomenclature.

An opposite view was taken by Mr. Norman R. Campbell (NATURE, vol. lxxxiv., p. 203, 1910), who urged the adoption without further delay of a system of nomenclature for the radio-elements which would admit of interpolation, and would explain relationships between objects named. Since this would constitute a permanent system of naming, those names which are acknowledged as temporary might be at once dispensed with without having to wait for an indefinite time in the future when all the elements in a series are assumed to have been discovered.

Little attention, however, seems to have been given to this suggestion. New elements have been discovered since then, and the names assigned to some of them are even more unsystematic than the names previously given to other elements of the same series. As examples of this diversity of naming may be mentioned mesothorium 1, radium C^1, and radium C_1.

It might be urged in defence of the names now in use that no satisfactory system has yet been devised which would provide for the naming of elements yet to be discovered, and would show relationships between elements either in a straight or branched series. The most favoured system of naming the radio-elements seems to be that by which an element is designated by a letter or number following the name of the first of a group of elements. Such a system, however, does not admit of interpolation, and there may thus be good grounds for the delay in adopting a permanent system of nomenclature.

The object of the present note is to direct attention particularly to the diversity and careless use of symbols selected to represent the names of the radio-elements now in use. The lack of uniformity in the use of symbols is illustrated by the following examples, most of which were taken from recent numbers of the *Philosophical Magazine* and the *Physikalische Zeitschrift* :—

Uranium.—U and Ur.

Actinium.—Ac, Act, and Akt.

Radium A.—Ra A, RaA, and Ra-A. The symbols of all other elements designated by a letter are likewise written in one or other of the three ways represented.

Uranium 2.—U 2 (or Ur 2), U_2, U-2, U-two, and U_{II}. A similar diversity is observed in the symbols of all elements which are designated by a number.

Radio-thorium.—Radio-Th, Radioth, Ra Th, Radth, Rad Th, Rad-Th, and Rt.

Mesothorium.—Meso-Th, Mesoth, Mesth, Mes-Th, and Ms.

Radium A, Radium B, and Radium C when considered collectively.—Ra A, Ra B, and Ra C; Ra A, B, and C; RaA+B+C; Ra(A+B+C); A, B and C; A+B+C. The active deposit of other series is likewise referred to in a corresponding variety of ways.

Such a diversity of symbols must be very confusing to the student in radio-activity, and particularly to the future student when referring back to the work of the present day.

No less confusing is the use of duplicate names in the case of several of the elements. Thus the product following radium is sometimes called radium emanation (Ra Em), and sometimes nitron (Nt); that following radium C is called radium D, and also radio-lead; and that following radium E has the duplicate names radium F (Ra F) and polonium (Po). These different names for the same element are often to be found in the same article. In the same way the terms X-ray and Röntgen ray are still used for the same radiation.

In an abstract journal like *Chemical Abstracts*, where only the symbols of the elements are used, it is particularly desirable that each element should be always represented by the same symbol. In the case of some of the radio-elements this is not possible since no standard symbols have yet been decided on. It would thus seem worth while to adopt by general agreement uniform symbols for the radio-elements, even although the names of some of the elements may be considered as only temporary.

WILLIAM H. ROSS.
H. JERMAIN CREIGHTON.

Swarthmore College, U.S.A., May 14.

Pianoforte Touch.

I HAVE been very much interested in Prof. Bryan's article on pianoforte touch in NATURE of May 8. There is, of course, no question with anyone who is a pianist that dynamic differences of touch produce enormous differences of quality in the tones of a well-made pianoforte. My own observations in the matter do not go very far, but, amongst other things, it has seemed to me that two things are important: (1) the harmonics of a note have always seemed to me to be most prominent when the note has been produced by the least possible "hit" by the fingers, in fact, when the note is practically produced by pressure alone. Pressure alone is, of course, unable to produce a note, and a certain fractional hit is always necessary to give the hammer the necessary momentum.

(2) As a result of (1), it seems worthy of note that variations in quality must be produced by differences in the time the hammer is in contact with the string. Since the sensitive fingers of a trained pianist will be able to produce an infinite variety of pressure and hit from the heaviest arm staccato to the merest "caress" of a key, it is possible to produce very large differences of quality as well as large differences in intensity.

My own experiences with a player-piano have made me well-nigh despair of its capabilities in its present form. In spite of the instinctive control it is certainly possible to obtain with it, its mechanical details seem to me to fall far short of the ideal that a musician can demand. It is, of course, practically impossible to produce a differentiation of intensity between notes of the same chord, and to a musical ear it is this difference of intensity which enables differences in quality to be detected and appreciated. Prof. Bryan seems to have been able to control this differentiation in quality in a solo passage, and if he can produce a mechanical arrangement which can even approximate to the sensitiveness of a pianist's fingers, he will certainly go far to make the piano-player more acceptable to musicians.

I have often endeavoured to make a player-piano play Chopin's First Ballade, but I have never yet succeeded in overcoming the uncompromising self-assertiveness of the mechanism. It seems to me a curious fact that while a piano-player can often play Beethoven acceptably, it fails hopelessly with Chopin, especially in works like the ballades and nocturnes. I have succeeded in getting presentable performances of the sonatas, and I had almost said of the scherzos, but the lack of flexibility of the instrument seems to make it impossible in music where differences in colour are so important as in the ballades and nocturnes.

Although I have no doubt it will be possible to devise a mechanical arrangement which will improve the player in the direction I have mentioned, yet it would seem impossible to make any mechanism sufficiently sensitive to be able to produce effects such as those which can be produced by the fingers, just as it may be possible to produce an aëroplane which is capable of marvellous evolutions, while it never attains the instinctive facility of a bird.

CHRISTOPHER W. C. WHEATLEY.

The College, Epsom, May 23.

On the Habitat of Protodrilus and the Occurrence of the Archiannelid, Saccocirrus, on the South Coast of England.

ONE habitat of Protodrilus on the English coast has already been mentioned in NATURE of March 27 (p. 85). This animal, however, has since been found in so many similar localities in the Plymouth district that there can be little doubt that it will be found on other parts of the coast when looked for in suitable situations. Protodrilus has indeed now been taken in numbers in eleven different localities between Salcombe and Looe.

In one of these situations there was found, along with Protodrilus, a species of the interesting genus Saccocirrus, which, as is well known, appears to link up the Archiannelids with the Polychætes. This genus has not apparently been taken outside the Mediterranean region except at Madeira, but, as in the case of Protodrilus, it may very likely be found on other parts of the coast when looked for in suitable places. Hence the following description of the habitat of these animals may induce some of the readers of NATURE to look for them on other parts of our coasts.

In all cases Protodrilus—and in one case Saccocirrus—has been found in gravel just below the high-water mark of neap tides where fresh water runs or percolates into the sea, and in nearly all cases the animals were taken at the lower level of a gravelly beach where the gravel passes into a rocky foreshore. Given these conditions in the Plymouth district, namely fresh water running over or percolating through gravel near the high-water mark of neap tides with rocks at the lower levels, and one is practically certain to find Protodrilus where the gravel meets the rocks, and especially under stones embedded in gravel in the pools at the junction of the gravel and the rocks.

In appearance the species of Protodrilus found near Plymouth, *P. flavocapitatus*, resembles a piece of silk thread about half an inch long, looking brownish-white to creamy-white on a dark background, and having a rosy-coloured portion just behind the head; the body is often curved in a characteristically sinuous manner, and may become rolled up into a close spiral coil if the animal is alarmed. Saccocirrus is very similar to Protodrilus in habits, but is larger, attaining a length of nearly 2 in., and having a correspondingly thicker body, which is opaque-white in colour. This species of Saccocirrus has not yet been determined, but it does not appear to be the same as the *papillocercus* of Bobretzky as revised by U. Pierantoni (*Ann del Mus. Zool. Napoli* (N.S.), vol. ii., No. 18, 1907).

J. H. ORTON.

The Laboratory, Citadel Hill, Plymouth.

Sub-Red Crag Flint Implements and the Ipswich Skeleton.

THE best reply to Mr. J. Reid Moir's criticism (NATURE, May 22, p. 296) on my paper in the Manchester memoirs discussing his sub-Crag flints will be the paper itself when published. The second part of his letter, dealing with the Ipswich skeleton, reveals so complete a change of ground that it is necessary to comment on it. In his original description (Proceedings of the Prehistoric Society of East Anglia, vol. i., part ii., p. 194) Mr. Moir laid very great stress on the fact that the contracted skeleton was lying partly embedded in glacial sand, and partly in decalcified boulder clay.

In a report (*ibid.*, p. 196) by Mr. W. Whitaker, F.R.S., appears the following:—"The bony cavity of the skull is filled with earth of the same kind as that beneath which the skeleton was found, a brown loam, and the filling is so thorough that a cast of the cavity has been made."

Dr. Arthur Keith, in his description (*ibid.*, p. 203) of the Ipswich skeleton, remarks "that on reaching the museum the bones were exposed by removing from them the overlying boulder clay and leaving them still *in situ*, on the underlying glacial sands," and adds, "There is the further advantage that anyone can now examine the exact relationship of the parts to the strata in which they lie."

Mr. J. Reid Moir now says "that in his opinion the skeleton was either buried in the sand, or else covered by blown sand to a considerable depth." In either case the skeleton, when found, should have lain entirely in sand and the cranial cast in boulder clay would have been impossible. Mr. Moir's present view is hence quite inconsistent with his original description of the occurrence, and, as he cannot have it both ways, he must choose which view he prefers to stand by.

W. H. SUTCLIFFE.

Littleborough, May 27.

Antennæ for Wireless Telegraphy.

I FIND that an iron bedstead with wire mattress on the top (fourth) floor of this house answers quite well as antennæ for the receipt of wireless signals. It is only necessary to connect the receiving apparatus, which includes a Brown relay, between the bedstead and the water-pipe to receive the Admiralty signals loudly, and others from various unidentified stations faintly but quite audibly.

I find also that with the bedstead antennæ it is possible to get the time signals from the Eiffel Tower. As might be expected, the signals are not very loud, but are sufficiently audible to be recognised and read easily.

A. A. CAMPBELL SWINTON.

40 Chester Square, S.W.

Use of a Carbon Filament Lamp to Charge Electroscopes.

I FIND that a very convenient way of charging an ordinary gold-leaf electroscope is to rub the charging rod with the glass bulb of a glowing carbon filament lamp. The leaf system becomes negatively charged. It is quite easy to charge a Braun electrostatic voltmeter to several thousand volts in this way.

There appears to be nothing mysterious in the phenomenon. The glass of the lamp is kept hot and free from moisture by the heat supplied from within, and is therefore always in a suitable state for producing electricity by friction against metals or other substance. It is obvious that the corpuscles shot off from the glowing filament and sticking to the inside of the bulb can have little or no part in the production of such high potentials, for the very greatest speed they could acquire would be that corresponding to the voltage of the supply mains. A glass tube filled with hot mercury can, in fact, be used as successfully as the lamp.

This lamp method of producing electricity by friction is so easy to employ, and, moreover, so certain in action (the degree of electrification can be regulated to a nicety), that it is bound to be of interest to users of electroscopes. R. Whiddington.

Naid or Tubificid?

In Nature for November 16, 1911 (p. 78), I directed attention to the fact that a tiny annelid known as Rhyacodrilus had been found in England, and that it differed in some respects from the specimens recorded for Switzerland. Some difficulty was experienced by the Continental authorities in assigning it a place. Ditlevsen contended that it belonged rather to the Naididæ than to the Tubificidæ, but Michaelsen in his various publications refers it to the latter. In his "Süsswasserfauna Deutschlands" he specially distinguishes those annelids which reproduce by fission from those which form cocoons, and places the Naididæ in the former group, while the Tubificidæ are relegated to the latter. Then he places Rhyacodrilus (=Taupodrilus) among the Tubificidæ, because it is possessed of sexual organs.

Aided by a Government grant for the study of annelid bionomics and economics, I have just been able to make an interesting discovery. Rhyacodrilus is found in our midland streams, and in the summer is possessed of all the organs belonging to the Tubificids. In the winter and spring, however, it adopts the Naid method of reproduction, and forms a chain (Tierkette). It is therefore a link between the two families, and the question arises: To which does it most certainly belong? I favour the Naid association.

Swadlincote, May 16. Hilderic Friend.

WORK OF THE EUGENICS RECORD OFFICE.

PROF. DAVENPORT and his staff of collaborators and "field" workers have shown great activity in the collection of family histories. The two first of a series of quarto memoirs, beautifully printed at the expense of Mr. Rockefeller, and published by the Eugenics Record Office, contain elaborate accounts of the members of two particular stocks whose claim to fame resembles and rivals that of the Jukes. The "Hill Folk," whose relationships with one another and with their common ancestry were investigated by Miss Danielson, comprise more than 700 persons all descended from two particular individuals who settled near a New England town in about the year 1800. Elaborate calculations as to their cost to the town and State for aid as paupers and for maintenance in prisons and institutions reveal the fact that these charges are constantly and rapidly increasing. Feeble-mindedness, alcoholism and the evils which spring from each or both in combination are terribly prevalent among them, and their distribution within the families is clearly shown in the extensive pedigree charts which embellish the memoir.

Although Prof. Davenport does not claim that the material here collected is of a kind suitable for the study of inheritance, it is of interest to note that from it he propounds a theory on the transmission of feeble-mindedness of a kind very different from that suggested by himself and Dr. Weeks in their paper "A First Study in Inheritance of Epilepsy" (Eugenics Record Office, Bulletin No. 4, 1911).

According to his earlier view, feeble-mindedness and epilepsy are both due to the absence of a gametic factor the presence of which is necessary for normal development. They are thus transmitted as a simple recessive character which might appear in either or both of these forms.

The material collected in the memoir under review, when analysed, gives results quite incompatible with this theory, and another and more complex one is consequently suggested. In the latter, which is propounded not as a dogma, but as a tentative hypothesis, different types of feeble-mindedness are taken into consideration, and it is supposed that each depends on the absence of a separate factor. Thus when two feeble-minded persons whose defect is of the same type are mated together, all their children will reproduce it, but where the type of mental defect of one parent is different from that of the other, none of their children need necessarily be feeble-minded at all.

The second memoir deals with a family to which the fictitious name of Nam has been attributed. The origin of the Nams is described as follows:—"In 1760 there lived in the mountains of Western Massachusetts a set of people called Nam, descended from the union of a roving Dutchman, who had wandered there from the Hudson Valley, and an Indian princess. These people were wealthy in land, having inherited it from their Indian ancestors." The family in more recent times is said to be characterised by alcoholism and lack of ambition. As in the case of the Hill Folk, Dr. Davenport has prepared a bill of what they have cost the State. We do not, however, agree with his system of accounting, in which everything is entered on the debit side and nothing on the credit. Even the most valuable of citizens would show up badly in this system. Thus the largest item of the Nams' account, forming two-thirds of the total, is their drink bill of rather more than a million dollars, distributed among 700 of them. If we were to take 700 prosperous professional men in England it would not be an overestimate to suppose that each would have a drink bill of something like 5000 dollars in fifty years, or, combined, their total bill for drink would be more than double the total bill of the Nams for all items. Thus, if nothing is reckoned on the credit side, we could come to the surprising conclusion that the Nams were the less unprofitable of the two.

The other publications of the Eugenics Record Office are their octavo bulletins. Of these, eight have appeared, three dealing with the inheritance of insanity. Special attention may be directed to that of Dr. Cotton, the medical director of the New Jersey State Hospital for the Insane (Bulletin No. 8, 1912). E. H. J. S.

LORD AVEBURY, F.R.S.

LORD AVEBURY, whose death on May 28 we recorded last week with regret, was a many-sided man, one of those gifted men who, without making any very profound advance in science, yet succeeded in making science acceptable and even welcome to the ordinary man. He was a banker by profession, and an antiquary, a politician, a man of science and of letters by inclination. He was born in London on April 30, 1834, the eldest son of Sir John William Lubbock, third baronet. His school was Eton, which, however, he left at a schoolboy age to enter his father's banking business. Throughout his life Lord Avebury, or, as he was for many years better known, Sir John Lubbock—he succeeded his father in 1865—showed a great capacity for steady, plodding work, not only in the City, but in politics, municipal administration, and in scientific and archæological research, and his activities were of the widest.

In 1870 Sir John Lubbock was returned for the borough of Maidstone, and he held this seat for ten years. In 1872 he became vice-chancellor of the University of London, and eight years later he was elected member for that university, and for the next twenty years he represented this seat of learning. He was active as a Parliamentarian, taking an especial interest in questions of education and social reform. He made a particularly good university representative, being a man of learning as well as of affairs. Amongst the many good causes he advocated, perhaps the establishment of bank holidays was the one most widely known and the one which will preserve his name the longest. In 1900 he was raised to the peerage as the first Lord Avebury, and it is characteristic of him that he chose a title intimately connected with archæology.

For many years Lord Avebury was a neighbour of Charles Darwin at Down, Kent, and it may have been their friendship that led to his interest in "Ants, Bees, and Wasps"; "The Senses, Instincts, and Intelligence of Animals"; "The Collembola and Thysanura"; "Flowers, Fruits, and Leaves," and in "The Origin and Metamorphoses of Insects," as five of his most illuminating books are entitled. He and his helpers added materially to our knowledge of the habits and instincts of social and other insects, and to our acquaintance with the activity of many forms of vegetable growth. His work, indeed, did much to pave the way for the great interest now taken in insects, especially at present in relation to the conveyance of disease.

But Lord Avebury by no means confined his attention to biological studies. He was an expert on banking; he was the first president of the Institute of Bankers, president of the London Chamber of Commerce, and for twenty-five years he was secretary of the London Bankers Association and president of the Central Association of Bankers. For five years he was president of the London Chamber of Commerce, and he published important treatises on coins and currency, and on municipal and national trading. His was a very steadying influence on the commercial world. Without having the dominant influence of a Pierpont Morgan, or the great American banker's power of handling a financial crisis, he had an infinite capacity for mastering detail, and a great gift for bearing in mind many things of importance which are apt to be overlooked in the ordinary course of business.

Lord Avebury took much interest in municipal government, and was vice-chairman of the London County Council in 1889 and 1890, and chairman from 1890 to 1892. Nor must it be forgotten that he was principal of the London Working Men's College, and did most admirable work in connection with that institution. His "Hundred Best Books" was the result of a lecture delivered at the college.

Few men have attained eminence in so many subjects, an eminence which would satisfy many a specialist. Part of this eminence was due to a gift of style. An American contemporary once described him as an "elegant British writer on bugs." Even his most strictly scientific monographs were written in an engaging manner, and none more so than his "Origin of Civilisation and the Primitive Condition of Man," which is now in its sixth edition. Perhaps of his scientific works "The Scenery of England" and "The Scenery of Switzerland" are the most enduring. The former is still recommended by the teachers in many a university as a most admirable introduction to the study of geology. He seemed to have an instinct for knowing "what the public wants," and his more popular literary works appealed widely to "the man in the street." "The Pleasures of Life," "The Use of Life," "The Beauties of Nature," sold by the hundreds of thousands—in fact, a quarter of a million of "The Pleasures of Life" have already been disposed of, apart from more than forty foreign editions. These books, though they partake of the nature of reprinted commonplace books, certainly hit the popular taste, and were in their influence wholly healthy and helpful.

In our restricted columns it would be impossible to enumerate the numerous associations over which Lord Avebury presided. He was, indeed, to paraphrase an Elizabethan phrase, "President General to the Age." He was president of the British Association in its jubilee year, and president of the Entomological, Ethnological, Linnean, Statistical, African, and Ray Societies; president of the Anthropological Institute, of the International Institute of Sociology, and of the International Association for Prehistoric Archæology; of the International Association of Zoology, and of the

International Library Association. Here, again, our space forbids us to catalogue his almost inexhaustible list of honours, but we must mention that he was a Commander of the Legion of Honour, and he held the Order Pour le Mérite. He was elected a Fellow of the Royal Society in 1858.

Lord Avebury married firstly Ellen, only child of the Rev. Peter Hordern, and secondly Alice Augusta Laurentia, daughter of the late General A. A. L. Fox-Pitt-Rivers, a granddaughter of the second Baron Stanley of Alderley. He is succeeded by his eldest son, the Hon. J. B. Lubbock, who is a partner in the banking firm of Robarts, Lubbock and Co.

PROF. J. T. NICOLSON.

THE early death of Dr. J. T. Nicolson, professor of mechanical engineering in the Manchester School of Technology and in the University of Manchester, will be much regretted by a wide circle of friends. His health during the past six months had given serious cause for anxiety, but had improved sufficiently to allow him to return to his duties. There followed a sudden relapse, and he died at Macclesfield on May 27 after a brief illness.

Prof. Nicolson was born at Amble, in Northumberland, in 1860, and received his early education at Watson's College, Edinburgh. He was then apprenticed to Hawthorne Leslie and Co., Newcastle-on-Tyne. From there he gained a Whitworth scholarship and entered Edinburgh University, where he graduated in 1889, obtaining the D.Sc. degree some years later. After graduation he spent two years in Charlottenburg, where he investigated the strength of materials under Prof. Martens. After holding the position of assistant-lecturer in engineering in the University of Cambridge, he was appointed in 1892 professor of mechanical engineering in McGill University, Montreal. He took an active part in the equipment of the engineering department and in arranging the courses of instruction for students. During his stay in Montreal he undertook an investigation with Prof. Callendar on the valve-leakage of steam on the surface of cylinders. This important investigation led to the award of the Telford premium to the authors. Prof. Nicolson resigned his professorship in Montreal in 1899 in order to take charge of the engineering department of the School of Technology, Manchester, and was largely responsible for the whole engineering equipment of that institution—an equipment which in variety and extent is even now unsurpassed in this country. When degree courses were instituted in the School of Technology in connection with the University of Manchester he was appointed the first professor of mechanical engineering, a position which he held until his death.

Prof. Nicolson's tenure of the chair at Manchester was marked by several important and extensive investigations. He made detailed experiments on rapid-cutting steels, in which he showed the relations between the cut and speed and the durability. The results of these investigations were published as a report by the Manchester Association of Engineers in 1903, and were well received by the engineering profession. As was characteristic of Prof. Nicolson, he immediately applied the experimental results to the improvement of the design of machine tools.

During the last few years of his life he took up the question of the transfer of heat to boilers. The late Prof. Osborne Reynolds had predicted in 1874 on theoretical grounds that the rate of transfer of heat from a gas or fluid to a solid surface should increase with the velocity of movement. This was confirmed for fluids by the experiments of Dr. Stanton in 1897. Prof. Nicolson, in an elaborate series of experiments, showed that the same result held for gases. He then applied this idea to the design of boilers and condensers, the essential point being that the heated gases were driven at a high speed through the tubes of the boiler, the water circulating in the opposite direction. As a result of an extended trial of a 60-h.p. boiler over sixty days, it was found that the efficiency of such a combination was considerably greater than that of the ordinary boiler. There has been much difference of opinion among engineers as to the practicability of this idea, but Prof. Nicolson himself had the strongest belief in the greater overall efficiency to be obtained by his methods.

The training of Prof. Nicolson fitted him admirably to fill the position of a professor of engineering, for he had not only a wide scientific outlook, but took a keen interest in the practical side of his profession. This is shown by the promptness with which he applied the results of his scientific investigations to the improvement of engineering practice. He was a man with strong opinions on engineering questions, and vigorously supported his position when attacked. His personal integrity, straightforward character, and sympathy with their scientific difficulties endeared him to his colleagues, while his vigorous personality and ability as a teacher made a strong and lasting impression on all his students. Owing to his increasing deafness he was unable in recent years to take that active part in administrative matters for which his wide outlook well fitted him. His premature death is a great loss to science, and will be much regretted by his colleagues both in Manchester and Montreal.

NOTES.

THE home list of honours conferred on the occasion of H.M. the King's birthday on June 3 includes three new Privy Councillors, seven new baronets, and twenty-six knights. The only fellow of the Royal Society in the list is Prof. E. A. Schäfer, professor of physiology in the University of Edinburgh, who has received the honour of knighthood. The same honour has been conferred upon Prof. J. H. Biles, professor of naval architecture in the University of Glasgow. Prof. T. H. Middleton, formerly professor of agriculture in the University of Cambridge, and now assistant secretary, Board of Agriculture and Fisheries, has been appointed a Companion of the Order of the Bath (C.B.). The appointments to the Order of the Indian Empire (C.I.E.) include Major G. K. Walker, professor of sanitary science, Punjab Veterinary College; Mr. L. Mercer, president of the Forest Research Institute and College, Dehra Dun; and Mr. J. H. Lace, Chief Conservator of Forests, Burma.

In opening, on Tuesday, June 3, the new buildings of the medical school at Guy's Hospital, Mr. A. J. Balfour delivered an address in which he pleaded for the endowment of research. In the course of his remarks he said :—Some people unacquainted with the movement of modern science may ask why it is that in 1913 apparatus, buildings, and expenditure of all kinds are required infinitely in excess of what was necessary even fifty years ago. The necessity arises not merely through the growth of the great urban population, but through the inherent progress of science itself. Fifty years ago some branches of science, such as physics, biology, and even some modern parts of chemistry, although studied by those who intended to devote their lives to medicine, had nevertheless an incomparably smaller connection with medicine than exists at the present time. As the connection of other collateral sciences with the science and practice of medicine has become closer, so the apparatus required has greatly increased in cost, so the amount of knowledge required from the teachers and the specialisation of the teachers have grown, until we may sometimes wonder how it is possible for any physician in a great practice even to keep himself abreast of what is being done in his own country and by researchers in all the other countries who are now engaged in happy rivalry for the furtherance of knowledge.

Besides the man of practical intuition and besides the man who can teach, Mr. Balfour added in the address referred to above, we want, if a medical school is to be all that it might be, a man who can investigate, a man who possesses that kind of originality which enables him to point out in what direction the next advance should be made, where progress may be expected, where nature may, under existing conditions, be most easily compelled to yield up her secrets. This man is the researcher. Genius is rare in any country and in any profession. All that organisation can do is to give to those rarely endowed individuals some opportunity by which they can exercise effectively for the common advantage the gifts which God has given them. If a man is going to devote to research hours which might profitably be given to the general practice of his profession, he must have a position of security in which he can feel that he is not sacrificing the interest of those nearest and dearest to him in the pursuit and advancement of new knowledge. The public must assist the great hospitals by a form of endowment which will enable them when they obtain a man with a genius for research to keep him and to use him. There are men who have quite a unique talent for research, who probably would not be very great clinical physicians. Places must be found for such men. This is absolutely necessary if there is to be a true organisation of medical research. The actual sufferings of the moment touch all hearts, but my appeal now is for the future, in favour of having academic lines of research of which the public knows nothing and yet on which depends the real future of the healing art.

The bicentenary of the Imperial Botanic Garden at St. Petersburg, which was founded in 1713 by Peter the Great, will be celebrated this month.

Lord Glenconner has presented 1000*l.* to the Edinburgh Royal Infirmary for the purchase of radium to be used in the work of the institution.

The twenty-fourth conference of the Museums Association is to be held in Hull from July 14 to 18, when Mr. E. Howarth will occupy the chair.

Prof. C. S. Sherrington, F.R.S., has been appointed an additional member of the Departmental Committee on the lighting of factories and workshops.

News has reached us from Mexico of the death, on April 23, at forty-seven years of age, of Prof. L. G. León, general secretary of the Mexico Astronomical Society. His death is deeply regretted by the members of the society, who appreciate highly his activity and work for astronomical science.

On June 11 the Right Hon. the Lord Mayor of London will officially open the Anglo-German Exhibition at the Crystal Palace. The exhibition includes a section on industry, with subsections relating to chemistry, surgical and optical instruments, electricity, and agriculture and forestry, among others.

An excursion to Minehead and district, West Somerset, has been arranged by the Geologists' Association for June 20–24. The directors are Mr. L. Richardson and the president, Dr. J. W. Evans. On the Saturday, June 21, there will be an opportunity to study the classic sections of Upper Keuper, Rhætic, and Lower Lias in the neighbourhood of Watchet.

Announcement is made that Mr. Arthur James has decided, as a memorial to his late brother, Mr. William James, to give the income of a sum of 20,000*l.* for cancer research to the Middlesex Hospital, as being the institution where clinical and pathological researches on the disease are most closely combined.

Prof. A. G. Ruthven, curator of the museum of the University of Michigan, is in charge of an expedition that will sail from New York on June 15 for Colombia, South America. The expedition will make its headquarters near Santa Marta, and will study the fauna from the sea-level to the mountain summits. The party will also include Prof. A. S. Pearse, of Wisconsin, and Mr. F. Gaige.

The autumn meeting of the Iron and Steel Institute will be held in Brussels, from Monday to Thursday, September 1–4. The opening meeting will be held in the hall of the Palais des Académies on Monday, September 1, when a selection of papers will be read and discussed. In the evening a reception will be held by the burgomaster at the Hotel de Ville. It is hoped that his Majesty King Albert will receive the members at the Royal Palace, Brussels, on September 2.

Three Chadwick public lectures, on nature and nurture in mental development, will be given by Dr. F. W. Mott, F.R.S., at the Royal Society of Arts, on Fridays, June 6, 13, and 20. Admission to the lectures is free. Information concerning future Chadwick lectures may be obtained of the secretary, Mrs. Aubrey Richardson, at the offices of the Trust, 8 Dartmouth Street, Westminster.

In February last the Italian Colonial Office appointed a commission to undertake the scientific study of the country of Tripoli. Prof. F. Eredia, of Rome, informs us that the commission has now travelled through the area, and has collected valuable geological, agricultural, botanical, and meteorological data. Meteorological stations have been established by Prof. Eredia in appropriate situations. Temperature and rainfall observations are to be sent from these stations to the Ufficio Centrale di Meteorologia in Rome, and will be published monthly, with the observations received regularly already from the Tripoli Meteorological Observatory.

We are asked to state that the British Fire Prevention Committee, having established a technical library that will be known as the International Fire Library, with a nucleus of more than 2000 books dealing specifically with matters of fire prevention, fire service, and fire loss, is now desirous of directing the attention of authors, public authorities, publishers, and collectors to the fact that a new catalogue is in preparation, and that any books, pamphlets, or reports which they are able to spare for this collection should be addressed as soon as possible to the honorary chief librarian, The International Fire Library, 8 Waterloo Place, Pall Mall, S.W.

The death is announced of Prof. Ernst Kittl, director of the geological and palæontological section of the Imperial Museum of Natural History, Vienna. Born in 1854, Prof. Kittl became custos of the Vienna Museum in 1893, and subsequently succeeded Prof. T. Fuchs as head of his department. He was the author of numerous papers and memoirs on fossils, chiefly Mollusca, and he prepared a valuable guide-book to the geology of the Salzkammergut for the meeting of the International Geological Congress at Vienna in 1903. For many years he was an active member of the Austrian Tourist Club, and from 1889 to 1898 he edited the publications of its natural history section.

The death is announced of Dr. Léon Pervinquière, lecturer on palæontology in the University of Paris. After a brilliant career as student in the University, he spent three years in investigating the geology of central Tunis, and on his return published an exhaustive volume on the region, with the best geological map of Tunis which has hitherto been prepared. At the same time he made a great collection of Tunisian fossils, which he afterwards studied in Paris, and the results of his researches were published in two handsome volumes on the Jurassic and Cretaceous Mollusca. Two years ago Pervinquière accompanied a boundary commission to examine the geology of the frontier between Tunis and Tripoli, and made valuable contributions to our knowledge of the extreme southern part of these countries. His untimely death at the age of forty is a serious loss to geological science.

The death is reported, in his fifty-sixth year, of Prof. W. Hallock, for the last eleven years professor of physics at Columbia University, New York. He graduated at that University in 1879, and then studied at Würzburg, where he was for a short time an assistant in the physical laboratory. Returning to America in 1882, he was successively a physicist on the U.S. Geological Survey, professor of physics at the Corcoran Scientific School, Washington, professor of chemistry at the National College of Pharmacy, and assistant in charge of the Astrophysical Observatory of the Smithsonian Institution. For ten years before his appointment to the full professorship he was associate professor of physics at Columbia. While on the staff of the Geological Survey he conducted the investigation of the subterranean temperatures in the dry well at Wheeling, where the drill went down to 4500 ft. below the surface of the earth. For three years Prof. Hallock was at work in the Yellowstone Cañon, investigating the phenomena of the hot springs and geysers there. Among other subjects that attracted his attention were the effects of pressure on powdered materials, and the thermal expansion of rocks.

An account has reached this country of the experiences of Mr. Frank Wild and his companions in the Antarctic. Mr. Wild led the second party of Dr. Mawson's Australasian Expedition. This party was dispatched by the leader to Sabrina Land or Knox Land; the existence of the former was disproved, while the latter was found to be unapproachable. The party, however, "landed" on a glacier in motion, and established a depôt on the land behind it. Thence the party divided, carrying out surveys east and west; the eastern section carried its work as far as 101° E., and explored inland for fifty miles, to an altitude of 4500 ft., while the western section worked along the coast to effect a junction with the surveys of the German expedition of 1902. Its route also lay at high altitudes. The discovery of the largest known rookery of emperor penguins is recorded. Severe weather conditions were encountered, and it is stated that the same blizzard which proved fatal to Scott held Wild's party prisoners for nine days. The new land was taken possession of in the name of Queen Mary's Land; it is a continuation of the King Edward VII. plateau, and has an upward slope towards the pole, and a coast-line of 350 miles.

A very interesting circular has just been issued by the Department of Mines of Canada, directing attention to the fact that an experimental laboratory for the concentration and treatment of Canadian minerals has been installed by the Department at Ottawa. The laboratory includes both small-scale laboratory apparatus and plant of working size, though, of course, not unduly large, for the practical treatment of bulk samples. The plant is to be operated free of all charges upon Canadian ores, the minimum amount for a laboratory test being 200 lb. of mineral, and for a working test not less than 5 tons. It is true that something of the same kind has been done previously in Australasia, but never upon the same liberal scale, and the intelligent enterprise of the Canadian Government in thus facilitating the development of mining and metallurgical industries in the Dominion cannot be too highly appreciated. It is sincerely to be hoped that the example may be followed elsewhere.

THE summer meeting of the Institution of Naval Architects is to be held in Glasgow on June 23-27. The premises of the Institution of Engineers and Shipbuilders in Scotland have been placed at the disposal of the visitors to Glasgow. Among the papers included in the programme of proceedings may be mentioned:—Dr. S. J. P. Thearle, note on some cases of fatigue in the steel material of steamers; Messrs. G. S. Baker and J. L. Kent, effect of form and size on the resistance of ships; Prof. A. H. Gibson and J. Hannay Thompson, experiments on "suction" or interaction between passing vessels; Mr. A. Cannon, experimental determination of the effect of internal loose water upon the rolling of a ship amongst a regular series of waves; Mr. Lloyd Woollard, effect of water chambers on the rolling of ships; Prof. L. Gümbel, on the criterion for the occurrence of cavitation. The programme also includes a variety of functions, visits to works, and excursions, in addition to the more serious business of the meeting.

MR. A. RADCLYFFE DUGMORE, the pioneer photographer of big game in their native haunts, and the author of "Camera Adventures in the African Wilds" and other works on kindred subjects, delivered, at the Æolian Hall on May 30, the first of two lectures entitled "Stalking Big Game with a Camera." This lecture dealt solely with his experiences in British East Africa, where he succeeded in getting some splendid flashlight photographs of lions creeping up to a "kill" at night, and of hartebeests drinking at a water-hole. He was very fortunate also in securing pictures of rhinoceroses, giraffes, zebras, gazelles, and buffaloes in the open, two of them, showing a large black rhinoceros in the act of charging the photographer, being particularly impressive. So close was the beast at the final click of the shutter that he had to be turned with a rifle bullet; but to Mr. Dugmore's credit be it said that he claims never to have used firearms unless his own life was in danger or unless meat was required for feeding the members of the expedition. Many of the photographs show beautiful spots in the scenery of East Africa, one with a group of Grant's gazelles in the foreground and the snow-clad summit of Kilimanjaro breaking through the clouds in the distance being especially charming. Mr. Dugmore is a clever and practised lecturer, and those who are interested in living animals could not spend a pleasanter hour and a half than by visiting the Æolian Hall this evening, June 5, when the second of the two lectures will be given.

MR. R. E. DENNETT, Deputy Conservator of Forests, Nigeria, a well-known authority on the negroes of West Africa, has reprinted from the Journal of the African Society a paper entitled "A Common Basis of Religion." In our existing knowledge of Bantu culture, derived from writers like Miss Mary Kingsley and Sir A. Ellis, it is startling to find the negro credited with a system of philosophy, including no fewer than 201 parts, each representing an Orisha, or departed spirit. It is said to be based on on elaborate scheme of symbolism, and the order of these symbols represents "to the psychologist what the periodic classification is to the chemist, or perhaps another form of Newland's law of octaves." The exposition, as it stands, is most ingenious, and the writer concludes by stating that by "superimposing the kinetic parts upon the potential in the moral and intellectual categories we note that the soul becomes the home of faith, the mind of idealism, the body of the senses, the will of life." At the same time, it must be remembered that the interpretation largely rests on the verbal analysis of native terms, and it may possibly be held that while our knowledge of Bantu philology scarcely warrants the conclusions, Mr. Dennett may have read between the lines of his authorities more than they may be reasonably admitted to bear.

A RECENT number of the Annals of Tropical Medicine and Parasitology (vol. vii., No. 1) contains a detailed study, by Major Christophers, I.M.S., upon the colour-markings and other variable characters of Anophelinæ, with special reference to the systematic and phylogenetic grouping of the species. The publication of this memoir in a medical journal may cause it to be overlooked by naturalists, to whom it should be of special interest. The author concludes that colour-markings can be utilised, equally with structural characters, in a natural classification of the anophelines and for placing species in groups to which they have affinities. A classification based on colour-marking approximates very closely to one based on scale-structure, but shows the affinities and relation between the groups much more clearly. The tendency of the phylogenetic evolution of the group is towards elaboration of ornament and development of scales; the more scaly an anopheline, the more advanced phylogenetically it would appear to be. Three main subdivisions are recognised; the Proto-anopheles, occuring both in the Old and New Worlds; the Deuteranopheles, chiefly African, South Asian, and Malayan; and the Neoanopheles, a peculiar Australasian type.

THE report of the Philadelphia Zoological Society for 1912-13 records a large increase in receipts over the previous year, this increase being distributed over every month of the year.

THE *Naturwissenschaftliche Wochenschrift* of May 11 (No. 19, Bd. xii.) contains an excellent summary, with bibliography, by Dr. Oberstein, of the fungoid diseases of animals and the bacterial diseases of plants.

WE have to acknowledge the receipt of a copy of the third part of vol. i. of the *Sarawak Museum Journal*, the contents of which include an article by Mr. C. Aurivillius on Bornean longicorn beetles, and a second, by Mr. C. J. Gahan, on those remarkable Indo-Malay coleopterous larvæ commonly termed "trilobites," the adult condition of which is still unknown. Mr. Gahan suggests that the larval stage may be permanently retained in the females.

Extinct North American horses, all referable to the modern genus, form the subject of a paper by Mr. O. P. Hay, published as No. 1969 (vol. xliv., pp. 569–594) of the Proceedings of the U.S. National Museum. Four species are described as new, two of these being based on teeth alone, while each of the other two is represented by the skull. No. 1975 (vol. xliv., pp. 649–654) of the same serial is devoted to the description of a remarkably fine skeleton of a zeuglodont lately set up in the museum. For these primitive whales Mr. J. W. Gidley, the author of the article, revives the extremely inappropriate name Basilosaurus, despite the fact that it was replaced by its sponsor, Sir R. Owen, by Zeuglodon when the mammalian nature of the remains became evident.

We have received reprints of two papers by Mr. W. E. Collinge on the relation of wild birds to forestry and on the destruction and dispersal of weed seeds by wild birds. In the former it is pointed out that but few wild birds are directly hurtful to forests in this country, the majority of species found in or near forests being distinctly beneficial owing to their destruction of insects and small mammals. Attention is directed to the importance of providing nesting-boxes in forests for the insectivorous birds. Merely to protect these birds is not sufficient; their multiplication must also be looked after. In the second paper many interesting details are given as to the frequency with which birds completely destroy even hard fruits and seeds, but there are so many cases in which the seeds pass through the bird's alimentary canal without being injured that the author cannot regard the seed-eating birds as a class as being beneficial—on the whole, they appear to act as distributors of weed seeds to a much larger extent than is generally supposed.

At the commencement of a very interesting article on our present knowledge of the earliest quadrupedal vertebrates (Tetrapoda), Prof. F. Broili points out that the occurrence of remains of land plants in the Lower Silurian of North America and the Upper Silurian of Kellerwald and the Hartz, coupled with their occasional presence in the Lower Devonian, may be taken as strong presumptive evidence of the existence of a contemporary vertebrate land-fauna. The first actual evidence of such an early fauna does not occur, however, until the Upper Devonian, and then only in the shape of the remarkable footprint from Warren County, Pennsylvania, to which O. C. Marsh gave the name Thinopus. Very noteworthy is the fact that this print represents a relatively large animal, vastly superior in point of size to the tiny salamanders of the succeeding Lower Carboniferous epoch, although equalled in this respect by Eosaurus of the Upper Carboniferous of Nova Scotia. Its evidence appears, however, quite indisputable, and we must therefore assume the Tetrapoda to have attained a relatively high degree of development in the Devonian, and thus to have been well represented in the Silurian. This being so, the Carboniferous and Permo-Triassic forms, interesting and in many respects generalised as they are, cannot be regarded as the earliest types, and, consequently, any attempts to formulate the phylogeny of the group must be to a great extent premature. The author has much to say regarding the structure and affinities of labyrinthodonts and anomodonts, but space permits only of the remark that he regards most of these, not even excluding dicynodonts, as amphibious.

We have received three numbers of the *Bollettino* of the Italian Seismological Society, forming a volume of more than 300 pages, and containing notices of the earthquakes recorded in Italy during the first half of the year 1909. The total number of entries is 726, all but seventy of which refer to shocks that originated within the area of Italy. This number, which is much greater than usual, is partly due to the frequency of the after-shocks of the Messina earthquake of December 28, 1908. Dr. Martinelli, the editor of the volume, connects 152 shocks with this great earthquake, but many shocks recorded at Messina and other isolated places, if more fully known, might have to be placed in the same category.

The Commonwealth Meteorologist has recently issued sheet maps showing the mean temperature and mean rainfall of Australia for the separate months and for the year. These maps confirm in the main those published in the "Atlas of Meteorology," so far as regards the south-eastern portion of the larger island; they extend the information over the remainder of the continent, and thus include Tasmania. The earlier maps, based on the *Challenger* results, show temperatures for six alternate months only. The most striking points of difference occur in the annual maps. The annual isotherms in the atlas map sweep southwards between the coasts; the new maps show roughly a sweep to the north. The annual isohyets on the new maps show much greater detail for the north and east coasts, and indicate that parts of the north coast receive more than 60 in. and Geraldton district on the Queensland coast more than 140 in. annually. The new monthly rainfall maps indicate clearly the winter rains in the south and the summer rains in the north.

According to the *résumé* of the communications made to the French Physical Society at the meeting on April 18, a large proportion of the evening was devoted to a discussion of the results of recent determinations of the radiation constants, σ of Stefan's law and c of Wien's and Planck's laws. One of the most recent and most accurate determinations of c is that of Warburg, Leithäuser, Hupka, and Müller, made at the Reichsanstalt, and reported in the April number of the *Annalen der Physik*. According to this determination c has the value 1·437 centimetre-degrees, a number which differs little from the mean of the more modern of the previous determinations. The determinations of σ differ much more seriously from each other. The oldest values lie between 5·0 and 5·5, while almost all the newer values are above 5·5, those of Valentiner and Westphal being 5·58 and 5·54 respectively, while M. Féry has in three sets of experiments obtained values above

6·0. M. Bauer attributes these high values to erroneous determinations of the corrections to be applied to the observations for the reflecting power of lamp black. He gives as the most probable value of σ deduced from his own and other observations $(5{\cdot}60 \pm 0{\cdot}04) \times 10^{-12}$ watt/(degree)^4.

AN interesting account of the survey of the Alaskan boundary, by Mr. J. A. Flemer, appears in *The Engineering Magazine* for May. The northern section of this line follows the 141st meridian. The initial point, determined by telegraphic longitude, is at the crossing of this meridian and the Yukon River. The azimuth of the meridian at this station was determined astronomically, and the line itself is being projected both north and south by two observers, one an American and the other a Canadian. The international projection party is being followed by a triangulation party. The topographical work is being executed by the plane-table method, since the climatic conditions in this part of Alaska have not that extreme character inherent to south-east Alaska, where the photo-topographic surveying method had to be employed. The triangulation party which precedes the topographic party furnishes the latter with the needed geodetic control, based on the field computations. The plane-table sheets are on 1 : 45,000 scale, with a horizontal contour interval of 100 ft., and the topographic details are mapped with the 141st meridian as the median line of a strip four miles wide. The boundary is being marked with aluminium-bronze monuments, the monument-setting party cutting a vista through wooded areas 10 ft. on each side of the meridian.

THE Academy of Natural Sciences of Philadelphia commemorated its centenary in March, 1912, by a number of conferences, of which an account was published in the issue of NATURE for April 11, 1912 (vol. lxxxix., p. 143). On that occasion the academy decided to publish several volumes in commemoration of the centenary, and one of these —an index to the entire series of its Journal and Proceedings, from the first volume issued in 1817 to the close of 1910—recently made its appearance. The index forms a volume of 1433 pages, and consists of a catalogue of the contributions under the names of authors, and a reference to all species, genera, families, &c., described or mentioned in the several volumes, arranged alphabetically. The expense incurred in the preparation and publication of the work has compelled the publication committee to make a charge for it. The price, 3.50 dollars, carriage paid, is less than the cost of production. Copies may be obtained from the editor, Dr. E. J. Nolan, Academy of Natural Sciences, Logan Square, Philadelphia, Pa., U.S.A.

A CLASSIFIED catalogue of second-hand books, journals, and monographs on zoology and other branches of natural science, including works from the library of the late Mr. Robert Shelford, sometime curator of the museum, Sarawak, and afterwards assistant in the Hope Museum of Zoology, Oxford, has been issued by Messrs. Bowes and Bowes, Cambridge, who have the works on sale. Mr. F. Edwards, Marylebone, London, W., has just issued a catalogue of books on ornithology and oology, including copies of the works of John Gould, H. E. Dresser, Lord Lilford, Henry Seebohm, &c.; also a series of native original drawings, in colours, of birds of India and Malaysia.

WE have received the first number of a new periodical, *La Science et la Vie* (April, 1913), the object of which is to popularise science. The principal contributions are :—Time measurements and signals, by M. G. Bigourdan; the construction and life of a big gun, by Lieut.-Col. Picard; the little agents of death (dealing with insect carriers of disease), by M. J. Paul Dupuy; and "Can the onset of old age be retarded?" by Dr. Toulouse. The periodical is profusely illustrated, and is issued at the price of one franc the number. The list of collaborators includes the names of many well-known men of science.

OUR ASTRONOMICAL COLUMN.

PERIODIC SPECTRUM OF 12 CANES VENATICI.—A Kiel telegram, dated May 30, states that Belopolsky has found that the star 12 Canes Venatici exhibits a spectrum that is periodic. Lines appeared on the following dates, April 22, 27·8, May 4, 9, and 22·5, but on seventeen days they have been invisible.

POSITION OF THE AXIS OF MARS.—Prof. Percival Lowell publishes, in the Bulletin No. 56 of the Lowell Observatory, his observations and those of Mr. Slipher of the position of the polar cap of Mars for the determination of the axis of this planet. The observations were made towards the end of the year 1911, but they include others made by Mr. Slipher in 1909. The values of the position of the axis are given in the case of each observer for every alternate year from 1901 to 1909. As regards the results and their accuracy, it is stated at the end of the paper that the mean of all Prof. Lowell's measures for the last fourteen years gives for the tilt of the Martian equator to the Martian ecliptic the value 23·5°, while that obtained by Mr. Slipher for 1909 and 1911 gives precisely the same value. In this publication Prof. Lowell refers to Prof. H. Struve's communication to the Berlin Academy, in which it is stated that the motion of the satellites affords a better determination of the Martian axis than direct measurement of the polar caps. This view is not acceptable to Prof. Lowell, who says, "it seems advisable to here correct a few misapprehensions," and these are contained in the present bulletin.

THE SOLAR ECLIPSE OF APRIL 16–17, 1912.—A communication by M. Simonin to the *Comptes rendus* for April 28 contains the results of the discussion of observations made during the eclipse of the sun on April 16–17 of last year. It will be remembered that the central line extended from Portugal to Russia, and along that line, scattered at various points, a great number of observers noted the times of interior and exterior contacts. In fact, a large amount of material was available for discussion, and this has now been completed. The conclusions may be summed up as follows :—

The right ascension and declination of the moon's centre, published for April 17, 1912, by the *Connaissance des Temps*, and corrected after Newcomb, ought to be increased respectively by 0·63s. and 4·3″. The calculated values of the semi-diameters of the sun and moon at the earth's mean distance give the figures 15′ 59·96″ and 15′ 32·16″. The sun's semi-diameter thus obtained exceeds by 0·33″ the value generally adopted for eclipses, while the moon's semi-diameter is a very little less than the mean of the two values adopted in the calculations of the *Connaissance des Temps*. The discussion also shows that the first exterior contact was in the mean observed six seconds too late, and the last three seconds too early, while the observations of the interior contacts were not affected by any such systematic error.

Details of the calculations will be published later in a memoir.

THE SPECTRUM OF NOVA GEMINORUM NO. 2.—The spectrum of Nova Geminorum No. 2 is the subject of a long communication by Prof. F. Küstner in *Astronomische Nachrichten*, No. 4654. Some time ago Dr. Giebeler, his assistant, published the results of a series of measures he made (*Astronomische Nachrichten*, No. 4582) of the fine sharp absorption lines in the nova spectrum, concluding that they gave an indication of the presence of radio-active elements. This paper contains an investigation by Prof. Küstner of the same and other negatives taken at Bonn of the nova, and the measures he secured and those of Dr. Giebeler are given together. The subject is discussed in considerable detail, and we can only here direct attention to the conclusions to which he has arrived with regard to the origins of 241 lines which are contained in his list. Thus he concludes that there is good evidence for the presence of uranium, titanium, and blue argon—that radium, manganese, and zirconium may be present, but that there is no evidence of the emanation, iron or vanadium. As regards calcium, helium, and magnesium he finds that certainly absorption lines observed corresponded to calcium H and K, probably also *g*, fairly certain He 4471·66, and questionable Mg 4481·34. It may be added that the wave-lengths of the enhanced lines of Lockyer were included in the investigation, and that little evidence was found for lines to be assigned to their origin; thus he rules out the presence of enhanced iron, titanium, and manganese. This paper should be read in connection with that recently published in the Monthly Notices of the R.A.S. by Prof. Newall and Mr. Stratton, who corroborate in the main the enhanced-line spectrum of the nova as first put forward by Sir Norman Lockyer in the case of Nova Persei.

SCIENCE, POLITICS, AND PROGRESS.

WE gave last week an account of the annual meeting of the British Science Guild and a summary of the report adopted at the meeting. We are glad to be able to supplement that article with abridged reports of the speech delivered by Lord Sydenham in proposing "that the best thanks of the British Science Guild be tendered to Viscount Haldane for his services as president since its foundation, and that Sir William Mather be elected to succeed him," and the reply made by Sir William Mather.

By the retirement of Lord Haldane, remarked Lord Sydenham, the guild was about to sustain a very severe loss, for in Lord Haldane they found a great leader and an inspiring power which had been of the utmost value in promoting the progress of the guild. It might be that there was a certain incompatibility between science and politics which the guild must strive in time to remove; or possibly science had not yet been brought to bear upon the delicate process of Cabinet making as it certainly should be. At least the spectacle of a Minister of the Crown who was a whole-hearted believer in the benefits of science and who could proclaim those benefits with knowledge and experience was a rare, if not a unique, phenomenon in this country. In Lord Haldane they had had an educationist who had long ago realised what technical education had done for other countries, and realised the deficiencies of the British Empire and had striven to remove them. And now the pleasant duty had been imposed upon him of proposing the election of his old friend Sir William Mather as their second president. The career of Sir William had been spent in the successful application of science to industry, and not only to processes and machines, but to men. It was in Sir William's great firm that the standard of forty-eight hours a week labour had long been adopted, and it was not an accident that for fifty years no strike had occurred in his business. As a member of Parliament, he was a persistent and consistent advocate of technical education. The guild has before it important national work. He (the speaker) felt confident that in Sir William they would have a most worthy successor to Lord Haldane.

Sir William Mather said he felt the deepest gratitude to the members of the guild for having so cordially elected him as their new president, but when he was first appealed to by Sir Norman Lockyer to take office he had some reluctance in assenting. He, however, had a great interest in the movement, for the British Science Guild claimed to teach the vital importance of using scientific methods in the common things of life. Those of them who were engaged in applying the fruits of scientific research and discovery furnished by the brilliant students of natural science realised the immeasurable debt the country owed to those who, in the long and patient work of laboratory experiment and the solitude of study, revealed the secrets of nature, and declared the scientific laws by which they might be adapted to the uses of man. The producers and manufacturers of the things that were used and consumed by the human race, and were necessary to its higher progress and happiness, had neither the time nor the requisite training to seek in the hidden treasure-house of nature for the sources of higher development. This was the work of the scientific explorer, and the guild embraced men who felt it to be a patriotic duty to encourage both the scientific explorer and the practical expert in the promotion of national prosperity and continual progress. They were beginning to realise in the twentieth century that there were latent forces in human beings as well as in nature that need to be exploited whereby their national welfare might be enhanced. The evils they deplored, the misery and suffering they saw among their fellow-creatures, were all preventable, and education in this matter became the most important thing in the world.

The British Science Guild had made education one of the chief objects of its study in relation to the training of children in their earliest years before the rational faculty became active, and this propaganda would be continued, for by this means only could the nation rise to higher achievements in removing the causes of poverty, misery, and disease, which affected the national progress, notwithstanding the wealth, power, and industrial prosperity which scientific discoveries had yielded to those who had been able to use them. It was not incompatible with individual ambition in the acquisition of wealth and power that the chief aim of the nation should be to encourage and support other means of adding to the contentment and welfare of the whole people. One of the most retrogressive conditions of present-day life in England was the recurring and increasing outbursts of passionate discontent amongst the working classes resulting in incalculable economic loss from strikes and lock-outs, and the deplorable absence of good feeling, sympathetic interest, and even patriotic effort between employer and employee. But did anyone consider that this was a normal or inevitable condition of things? Surely not. It was the result of human forces ignorantly applied and producing woe where the common weal should prevail. Both parties in the struggle usually displayed an equal amount of ignorance, but with a truly educated people all industrial progress should be admittedly dependent on the perfect accord between capital and labour in the pursuit of an end mutually advantageous. The lamentable condition of things had been of late the subject of Parliamentary and Government concern. Admirable means, including the recommendation of the principle of the minimum wage, had been devised and must be continued, but meanwhile the whole nation was being kept in a condition of inefficiency compared with what they knew would be possible were the whole industrial population of employers and employed working together in perfect accord and with the common aim of producing the most perfect products at the minimum of cost and maximum of benefit to both labour and capital. Such accord would, he believed, be found to lie in some system of profit-sharing between employer and employed, which if scientifically applied would most certainly lead to increased efficiency and contentment.

He submitted, therefore, that it would be a proper function of the British Science Guild to study and, if possible, to initiate by some considered recommendations a new order of industrial organisation, based on scientific principles of management, in which full justice would be done to all the interests involved in developing to a condition of maximum efficiency the great resources of the nation.

At the banquet of the British Science Guild, held on Monday, May 26, the following speech was delivered by Sir David Gill, K.C.B., in proposing the toast of the guild:—

I have been asked to propose the toast of the British Science Guild—and I rise to do so with much pleasure, because I feel and know that the objects for which it was founded are most worthy, and because in many directions the guild is doing good and useful work.

The aims and objects of the guild may be summarised in a few words, viz. to bring science and scientific habits of thought to bear upon the problems of everyday life and administration. The guild has no politics in the ordinary sense of the word. It belongs to no political party—its object is to help any party, be it Radical or Conservative, or any department of State, any Parliamentary Committee or individual administration with advice or assistance based on scientific knowledge.

It is sad to think how very few of our leading politicians—how very few, indeed, of our members of Parliament—have any serious knowledge of science; and yet it is upon science, and largely upon science alone, that the whole progress of our modern civilisation depends. I would be the last man in the world to deny the advantages of culture as it was understood 100 years ago. I mean the civilising, the refining, and the elevating influence of literature, art, and philosophy, apart from modern science based on experiment and observation. But it is not by progress in the older directions that we have to look chiefly for the modern betterment of mankind—the betterment of the health, the comfort, the safety, and the convenience of the great body of our fellow-citizens. We must go back to the days of Greece for the sculptures that in the present day we strive to emulate; and the like is true of the architecture of Greece and of our early cathedral builders. We have to go back to Giotte for reverence in painting, to Holbein, Titian, Giorgioni, Rembrandt, and Velasquez for other qualities in art that we cannot equal in the present day. In literature it is the same story—Homer, Virgil, Shakespeare, Dante, and Milton are not of our day, nor have we since seen their like. In philosophy I doubt if we have made much real advance since the days of Plato.

But in science what has not the progress been in recent days? That is a story known to you all, and I need scarcely dwell upon it. Tycho Brahe, Kepler, and Newton have laid the foundation of the fair superstructure of modern dynamical astronomy; and Stokes, Kirchoff, and Bunsen have laid on a no less sure foundation our present-day knowledge of the chemistry of suns and worlds other than our own. Chemistry and physics have advanced with giant strides within the last century, and in the present day we see the dawn of a knowledge of the constitution of the atom.

The invention of the steam engine is, by comparison with the fullness of art in the days of Greece, a thing of yesterday, and so practically is the scientific coordination of the laws of heat and electricity, the invention of the dynamo, and the transformation of energy into light and heat and *vice versâ*. The mythical æther is used to convey our wireless messages around the world, and we can travel on sea and land with a rapidity, comfort, and luxury almost undreamt of by men of only fifty years ago. We can travel, if we so desire, under the sea or over the sea, or we can fly in the air.

Medical science has made marvellous strides. Pain and suffering have been diminished and life has been prolonged. All these are steps in the progress of mankind, in the betterment of the conditions of life, which we owe to science and to science alone. I am aware that there is still a school of men who contend that we are no happier or better for this progress. I need scarcely say that I do not agree with them, but I do not propose to bore you with arguments on so trite a subject; the simple fact remains that if we, in these little islands of ours, do not progress with the times by the aid of science and the cultivation of our manhood, we shall be left behind in the race of progress—a strong man armed will come upon us and our inheritance will another take.

That is absolutely certain; so that whether the men of old were wiser and happier without science is not a question that requires discussion. The simple alternative is whether, in face of the competition of other nations, we of this presently great Empire are to be content to give up our place and power, or whether by the successful cultivation of our manhood and our science, we shall keep our place among the nations. Since science is so important to our existence as a nation, is it not strange that amongst our leading legislators there are so few who have any reasonable acquaintance with science?

I do not speak so much of the ordinary member of Parliament—he, poor man, in the present day, has got very little to do with the government of the country. He may have his convictions, he may have devoted time and knowledge and thought to the preparation of a useful Bill—but the chance of getting it even discussed by the House of Commons is small indeed; he may be thankful if he is not compelled by the crack of the party whip to vote for something that is in total opposition to the principles of his own Bill.

The real government of the country lies thus in the hands of a comparatively small number of men, and too often of men who have been selected for fluency of speech, readiness in debate, and a certain personal magnetism that appeals to the masses, rather than for the qualities of the highest statesmanship and sound scientific knowledge. The politician as a rule has had an eye to politics from an early age, and his reading has gone in the direction of history and political economy, generally to the entire neglect of the more exact departments of science, and, above all, he prefers votes to history, political economy, science, or anything else. The instincts of the man of exact science are indeed opposed to those of the normal party politician. The man of science must be very sure of his grounds before he makes a statement, and must rigidly compare all existing facts with any theory before he declares the probability, or his personal conviction, of its truth. Above all, he must be careful to avoid the influence of preconceived views of his own or the views of his friends before he draws his inferences from observed facts. Where would the party politician be if he based his action on such grounds? He would soon be hounded out of his party, or reduced to slavish submission by the party whip.

So long as we have party government I fear there is no escape from the predicament. The object of the Science Guild is to provide some partial remedy at least for this undesirable state of affairs.

When Ministers have on any particular subject recognised the need of scientific advice they always have the Royal Society to which they may apply, and from that society they can always obtain sound advice on any subject that involves exact science. But it needs some scientific knowledge to know when sound scientific advice is required; and too often Governments do not know when they should ask for such advice, or they may know enough to realise that acceptance of the advice they require might involve expenditure that would not purchase votes or might lead to action that would be unpopular with some of their constituents.

Now it is here that a body like the Science Guild may rightly and does most rightly and properly come in. Unlike the Royal Society, it does not wait to be consulted. As a non-political body, it desires no party advantage from its action. Therefore when a Bill is in course of preparation or discussion in which it is clear that scientific advice has been neglected or not demanded, the Science Guild refers the matter to a competent committee of its own, and tenders advice without solicitation. It does not stump the country to proclaim its views; it leaves to the Government or the member who fathers the Bill the responsibility of adoption or non-adoption of its advice; it leaves to others to use any further pressure that may be required, based upon the views of the Science Guild.

Our guild is yet young, and it takes time before the elector at large can realise the due weight of its views. But no one can question the competence of its committees; the men who compose them are well known for their scientific standing and sound practical common sense; and, as time goes on, Governments will more and more find the importance of listening to the advice so tendered. No man was more sensible of this than was Lord Haldane, who has been our president since the formation of the guild nearly seven years ago. It is with much regret we learn that the pressing duties of his high office have compelled Lord Haldane to resign the presidency of the guild. We are most grateful to him for the services he has rendered, and for the recognition he has given to the value of the work aimed at and done by the guild.

We all, I am sure, are gratified to know that the Rt. Hon. Sir William Mather has consented to fill the chair vacated by Lord Haldane's retirement. He, as we all know, has taken a prominent part in the promotion of technical education throughout the country. He has been an able and active member of the guild, and we all have confidence that in his hands and under his inspiring influence the work of the Science Guild will grow and flourish.

JOINT MEETING OF BRITISH AND FRENCH ELECTRICAL ENGINEERS.

DURING the joint meeting of the British and French Electrical Engineering Institutions, held in Paris on May 21–24, a wide range of subjects was discussed. The greater part of the time was devoted to electric railway traction. The electrical equipment of purely urban and suburban railways has already become almost a mere question of economics and technical detail; the broader engineering and scientific problems are solved. So far, however, the replacement of the steam train by the electric train on main lines has only been limited, and this is a work for which the electrical engineer is making ready. Its consideration cannot be deferred until the improvements in the economy of generating and distributing electrical energy, and converting it into mechanical energy on the train, are such that there can be no other reasonable method than to burn the coal at the pit's mouth instead of the locomotive furnace; for in the meantime the "electrification" of suburban lines must continue, and the railway engineers naturally desire to equip their lines on some system which will lend itself to main line traffic as well as suburban, without extensive alterations being necessary when the second part of the problem is taken in hand. For this reason, the presentation and discussion of six papers on electric railways by French electrical engineers of high repute was particularly well timed.

The chief reason for different methods in dealing with urban railways pure and simple and main line railways may be summed up in two words, viz. distance and locomotives. On an urban or suburban line, the energy required is spread over a comparatively small geographical area; while on a main line the energy has to be transmitted over a considerable distance. Again, the traffic on an urban or suburban line is mainly passenger traffic, while a large proportion of the traffic on a main line is for the conveyance of goods.

In the majority of suburban lines a comparatively low electrical pressure (500 or 600 volts) is carried on the conductor along the track; this means a proportionately large current is required, but the voltage-drop and loss of energy which this entails are not serious on account of the small distance between the power station or substation and the train. Partly to facilitate the conveyance of this high current from the conductor rail to the train, and partly to enable trains to be conveniently subdivisible into lengths corresponding with the density of traffic at various periods of the day, the "multiple-unit" system is employed, in which there are two or more motor-coaches on each train, each taking current from the "live" rail conductor, but all controlled from the cab of the front motor-coach.

On long main lines, on the other hand, it is obviously more economical to transmit the energy to the train in the form of a higher potential and lower current, and this is the more desirable owing to the necessity of using locomotives, at all events for the goods traffic, which entail transmission of the whole of the current to the train at one point or one set of contacts with the live conductor. Therefore, other things being equal, a high-pressure single-phase current, as is being used on the London, Brighton and South Coast Railway, and also to some extent on the Midland Railway, and on several American and German lines, is indicated as the solution to the problem so far as main line traffic only is concerned; it is easy to generate and transmit, and requires only one live conductor, which is overhead. On the other hand, the overhead work introduces complications and expense for suburban traffic in which there are many lines of tracks and many points and crossings, the equipment of a single-phase locomotive costs more and weighs more than that on any other system, and, last but not least, there is a great risk of serious disturbance to telephone and telegraph lines in the neighbourhood due to both electrostatic and electromagnetic induction.

In three-phase working, as used on most of the Italian electric railways, the second of these three disadvantages does not obtain, but the first disadvantage is accentuated owing to the need of two live conductors for each line of track, and the possible effect on the telegraph and telephone lines is the same. The high-tension continuous-current system is growing in favour, therefore, but it suffers from other disadvantages, although it would certainly appear to fulfil most completely the conditions required in a large number of cases. Standardisation is, of course, desirable for railway working, owing to the through traffic from one line to another, and many suburban lines are already equipped on the medium-pressure third-rail system. In the full discussion of the subject in Paris, the relative values of these and other technical points were weighed.

Among the other papers read at the Paris meeting was one by Mr. W. Slingo, engineer-in-chief of the British Post Office, on certain auxiliary apparatus in telephone exchanges. He described a class of apparatus, originally evolved in connection with automatic telephone exchanges, which is now being applied by the Post Office in some of the manual exchanges in London to assist in the distribution of traffic. In ordinary exchange working, when a subscriber removes his telephone from the hook, a lamp corresponding to his number glows, being actuated through a relay, and the operator to which this number is allotted, or one of the operators on either side of her, places a plug in the subscriber's answering jack immediately by the lamp, and makes the necessary connection. In spite of there being three operators who can attend to any subscriber in the busy hours of the day, there is nevertheless a certain amount of time in which each operator is not fully engaged. In the new "Avenue" exchange, an endeavour to level the work of the operators was made by using "ancillary" jacks for each subscriber, multipled over two other sections of the board, so that any one of nine disengaged operators could take any call. In the new system, however, this distributing of the calls to a free operator is made absolutely automatic. The allotment of groups of subscribers to definite operators is discontinued. As soon as a subscriber lifts his telephone from the hook, an automatic switch at the exchange end of his line selects a line leading to any operator who is idle for the moment, the calling lamp at her position glows, and she immediately answers the call.

Two lectures were given on the closing day of the meeting, one, by M. Georges Claude, on the neon light, and the other, by Commandant Ferrié, on the Eiffel Tower time signals. A discharge in a tube of neon gas gives a very pleasant red or orange-red light, which is, however, absolutely devoid of blue rays. M. Claude proposes to combine the use of these tubes with mercury-vapour tubes, and as the latter are rich in blue rays and devoid of red, a more or less white light is obtainable. A difficulty arises in the fact that while the neon tube requires high-tension alternating-current for the luminescent discharge, the mercury-vapour tube requires low-pressure continuous current. It appears, however, that M. Claude uses in his "correcting" tubes both neon and mercury, which, he said, renders them suitable for alternating current (the exact physical explanation of this was not given in the lecture), so that both tubes can be connected to the same circuit. He gave the efficiency of the combination at about 0·8 to 0·9 per candle.

Commandant Ferrié's lecture on the Eiffel Tower time signals was extremely interesting, but as this subject was described in detail in NATURE of March 13, it is unnecessary to do more than mention it briefly now. The time signals at present are sent out twice daily, from 10.44 to 10.49 a.m., and from 11.44 to 11.49 p.m. From July onwards there will be some alteration in the times for sending out these signals and also in the character and sequence of the warning signals. The times for the exact time signals will then be altered to 10 a.m. and midnight. To enable the greatest possible accuracy of observation, a series of 180 short dots regularly spaced at one second less about 1/50 of a second apart are sent out immediately before the ordinary night signals. To facilitate counting, the 60th and 120th dots are omitted. This series of dots is received by the Paris Observatory and other observatories, in each of which the operator listens at the same time to the beats of the master clock or another seconds chronometer. The two sets of beats thus constitute an "acoustic vernier," and during the time that the 180 wireless dots last, three coincidences spaced thirty seconds apart occur between the wireless dots and the beat of the clock. By noting the time indicated by the chronometer at the moment of coincidence, as well as the number of wireless impulses heard before the coincidence occurs, it is possible to calculate the time of the chronometer at the receipt of the first wireless impulse. For instance, if the Greenwich mean time of a coincidence was 23h. 30m. 25s., and the number of the stroke at coincidence was 42, the time of the first beat will have been 23h. 30m. 25s. minus 41 $(1-1/50)$ seconds = 23h. 29m. 44·82s.

PROF. BERGSON ON PSYCHICAL RESEARCH.

PROF. HENRI BERGSON delivered his inaugural address as president of the Society for Psychical Research on Wednesday, May 28, in the Æolian Hall, New Bond Street. At the close of the address, which was delivered in French, and held the close attention of the company for nearly an hour and a half, Mr. A. J. Balfour, a past-president of the society, rose to express the thanks of the hearers, and characterised the address as the most interesting and illuminating one that the society has ever received. When we recall that Mr. Balfour himself, Prof. William James, Lord Rayleigh, the late F. W. H. Myers, and many other distinguished men have held the office of president, we can but feel that M. Bergson has justified both the choice of the society and his reputation as a maker of new thought.

M. Bergson took as his principal theme a study of the nature of the prejudices against the work and methods of the society; in fact, against its very existence—prejudices felt, not by the uninformed and unlearned, but by men of science, keenly desirous to extend the bounds of human knowledge. He attributed the objection to the methods which the experimenters in psychical research were forced to adopt in order to pursue their investigations methods akin to the judicial, the historical, or even to those of the criminal detective, but, since the Renaissance, foreign to the world of natural and experimental science. The great development of mathematical science, based on the recovery of Greek learning, and carried forward by such men as Kepler, Galileo, and Newton, had given to the modern mind the conception of scientific proof drawn from a series of accurate measurements of time, space, and mass which can be repeated at will, so that the man of science of to-day is inclined by his traditions and training to set aside as unworthy of consideration all phenomena which are incapable of treatment by the methods of precision and logical proof. Experimental psychology, however, that can measure rates of fatigue of memory, or persistence of association, has been received into the fold of orthodox natural science, and is making great progress towards a better comprehension of the workings of the human brain.

But readers of M. Bergson's book, especially those acquainted with "Matter and Memory," will recall that M. Bergson looks upon the human brain merely as a means of obtaining recollection, *un organe de rappel,* not as the essential phenomenon of human consciousness or of the life of the mind. Thus by the investigations of modern experimental psychology, we learn more about the instrument of communication between the outer and inner worlds—we do not extend our knowledge of those worlds themselves.

M. Bergson suggested that the function of the brain, and indeed of the recognised senses, is to limit rather than to extend the outlook of the mind. They become the organs of attention to life, picking out and preserving ready for use only those impressions and recollections which will be serviceable to the life of the individual or the species. Everything else is masked and put away where, in normal circumstances, it does not distract the attention of the participant from the things which help him to accomplish his mission in the world. But in certain circumstances, such as illness, shock, approaching dissolution of the partnership between mind and body, the limitation may suddenly disappear, the barrier breaks down—perhaps the reason for its existence is removed—and we get produced the phenomena with which the Society for Psychical Research is accustomed to occupy itself, regardless of mathematical theories concerning the nature of proof.

EXPOSURE OF THERMOMETERS FOR THE DETERMINATION OF AIR TEMPERATURE.

THE report of the Prussian Meteorological Institute for 1911 contains the fourth communication by Prof. G. Hellmann upon the above subject. The observations are discussed at considerable length under three principal heads :—(1) Exposure at a north window (formerly the usual method adopted in Germany) and in a Stevenson screen in a meadow (or field) at Potsdam. This section is accompanied by an interesting set of monthly diagrams showing the mean daily range due to both exposures. (2) Comparison of the Stevenson screen with the aspiration thermometer at Potsdam and Grünberg, in Silesia. (3) Comparison of the true air temperature in a meadow and in the north shade of Potsdam Observatory (about half a metre from the wall).

The following shortened summary gives some of the chief results deduced from the four communications :—

(1) The determination of the temperature near the north wall of a building is practically independent of the nature of the window exposure; the thermometer may even be hung freely, so long as it is not exposed to direct or indirect radiation.

(2) An aspiration thermometer installed near the north wall of a building gives results agreeing very closely with those of the usual window exposure; in the summer half-year the latter gives 0·1°–0·2° (C.) higher readings in the afternoon, while in the winter season the morning and evening observation hours give rather too low readings.

(3) A freely exposed Stevenson screen gives in North Germany too high readings at the afternoon observation throughout the year to the extent of 0·1°–0·2° in winter, and 0·2°–0·4° in summer. At the evening reading also it is 0·1°–0·2° too high in summer, and 0·1° too low in the other seasons; at other hours the differences are very small and of varying sign.

(4) The errors of this screen differ in different climates and with varying conditions of weather.

(5) The true temperature in the shade, on the north side of a building, both as regards absolute amount and daily period, is quite different from that obtained in an open field. At the 2h. p.m. reading the excess of temperature in the field is 0·1° in December and 1·0° in July. These differences increase with duration and intensity of sunshine, and decrease with strong winds.

(6) The true daily means in the north shade of a building and in a meadow differ but little from each other; in winter the meadow daily mean is 0·1°–0·3° the lower of the two.

(7) The hourly readings in the two positions are not comparable, but the daily means derived from the hours 7, 2, 9 by Kämtz's formula exhibit relatively small differences.

(8) The daily oscillation of temperature near the house is about 0·3° in December to 1·6° in June less than in the meadow.

(9) The daily maximum is from 0·1 hour in December to 0·9 hour in June later in the shade of the house than in the meadow, but the time of the occurrence of the minimum is the same in both positions.

HYDROGRAPHY IN ITALY.[1]

THE third annual report on the activities of the Italian Hydrographic Department deals with the year 1911, a period which is stated to have been of particular importance in its history, on account of certain drastic changes which were brought about in the administration of the service, through the passing of a law for the better regulation of the work of collecting and classifying data relating to rivers and their mountain basins, to lagoons and to the sea, and for the systematic study of all streams, their sources and outlets.

This new law assigned to the hydrographic service, in addition to the director, four specialist assistants, and has rendered possible the subdivision of the department into four sections, distinguished as fluvial-hydrographical, maritime-hydrographical, meteorological, and geological.

The report deals with the present and proposed fields of operations, and enumerates the various sub-services to be undertaken. These are as follows :—(*a*) Meteorological; (*b*) aërological; (*c*) telegraphic, for forecasting the weather; (*d*) meteorological, for the city of Venice; (*e*) midday signalling for the port of Venice; (*f*) pluviometric; (*g*) nivometric; (*h*) hydrometric; (*i*) stream measurement; (*l*) flood prediction; (*m*) levelling observations; (*n*) maregraphic; (*o*) maregraphic for the city of Venice; and (*p*) maritime lagoon reclamation. Of these services (*b*), (*d*), (*e*), and (*g*) were only inaugurated in 1912.

Within the limits of a brief notice it is not possible to do more than thus indicate in very general terms the extent of ground covered by the report, and those who desire fuller information or who are interested in any way in the extension and development of hydro-

[1] "Terza Relazione Annuale del Direttore dell' Ufficio Idrografico." By Giovanni Magrini. Pp. 71+plates+maps. (Venice: Carlo Ferrari, 1912.)

graphical research can only be referred to the brochure itself, the seventy pages of which contain much useful and instructive data. Included will be found a number of photographs illustrating various stations, and diagrams showing the method of taking observations. In addition there are four relief maps of the north-eastern portion of Italy (Venice and the adjacent provinces), indicating the scope of operations and their localisation. There is an interesting description of the construction of an experimental tank at Stra.

POSITIVE RAYS OF ELECTRICITY.[1]

The first part of the paper contains a discussion of the evidence afforded by the positive rays as to the nature of the ionisation of the gases in a discharge tube and the properties of atoms. The positive rays consist of:—

(1) Atoms with one positive charge.
(2) Molecules with one positive charge.
(3) Multiply charged atoms.
(4) Atoms with one negative charge.
(5) Molecules with one negative charge.

All the diatomic gaseous elements which have been examined furnish both atoms and molecules with single charges. The proportion of atoms to molecules varies very largely with the conditions of the electric discharge, and evidence is given that the charged atoms and molecules are produced by different processes. It is suggested that the ionisation which gives rise to molecules is due to kathode rays, while the charged atoms are produced by the impact of charged atoms and molecules.

All the elements examined, with the significant exceptions of hydrogen and a substance of atomic weight 3 (X_3), furnish, under certain conditions, atoms with more than one charge. The power of acquiring multiple charges seems to be connected with the atomic weight rather than with the valency or other chemical property of the atom. Thus the atom of mercury, the heaviest atom investigated, can have as many as eight changes, crypton five, argon three, while the lighter atoms, as a rule, have only two. No undoubted case of a doubly-charged *molecule* of an element or compound has yet been discovered.

The negative charge is found on the atoms of some elements, *e.g.* hydrogen, oxygen, carbon, sulphur, chlorine, but not on the atoms of nitrogen, helium, neon, argon, or mercury. It may be regarded as an indication of the chemical activity of the atom, in so far as this depends upon the intensity of the electric field outside the atom. No negatively electrified molecules of compounds have been observed; the only cases of negatively electrified molecules of elements are those of oxygen and carbon, and these only occur when the elements are liberated from special types of compounds.

The second part of the paper deals with the use of these rays as a method of chemical analysis. Several applications of the method are considered. The first of these is to the detection of rare gases in the atmosphere. It is shown that while none of the heavier gases in the atmosphere occurring in quantities comparable with that of xenon have escaped detection, this is not the case with the lighter gases.

"Neon," it is shown, is not a simple gas, but a mixture of two gases, containing a large quantity of a gas of atomic weight about 20, and a much smaller quantity of one with an atomic weight about 22. The "22" gas was first observed in samples of residues of liquid air supplied by Sir James Dewar, and has since been found in every specimen of neon examined, including a specimen supplied by M. Claud, of Paris, and a very carefully purified sample of neon prepared by Mr. Watson. The sample from M. Claud contained a small quantity of a substance with atomic weight 3, the properties of which are discussed later on.

Another application of this method was to the analysis of the gas in a small glass tube in which 30 mg. of radium bromide had been sealed for more than ten years; in addition to helium, the gas contained considerable quantities of "neon" or some element with very nearly the same atomic weight; there was also a trace of argon in the gas, a little more than would have been expected from the volume of air in the tube, although the difference was not very great.

The other application of the method is to the investigation of the properties of a substance for which $m/e=3, X_3$. This gas is given off by most solids when they are bombarded by kathode rays. Reasons are given for concluding that the substance is not the carbon alone with four charges.

The gas has the following properties:—

It can pass through tubes containing red-hot copper oxide, and then over potash without being absorbed.

It is not changed when sparked for a long time with an excess of oxygen, the oxygen being subsequently removed by phosphorus.

It can pass over metallic sodium without being absorbed, nor does it disappear when heated along with sodium vapour.

It is absorbed by charcoal cooled with liquid air, but it can circulate through a glass spiral immersed in liquid air without being condensed.

It combines with mercury vapour when an electric discharge is sent through the mixture; it also combines to some extent with red-hot copper when passed slowly over it. If stored over mercury vapour it seems to diminish, though very slowly. The gas has been detected after it has been stored for several weeks.

The study of the positive-ray photograph indicates that the substance is monatomic, and generally it seems to be similar in its behaviour to the inert gases, although its chemical properties are apparently a little more energetic.

[1] Summary of the Bakerian lecture delivered before the Royal Society on May 22 by Sir J. J. Thomson, O.M., F.R.S.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—Dr. Shipley, master of Christ's College, has been reappointed representative of the University on the council of the Marine Biological Association.

On June 3 the Rev. S. A. Donaldson, master of Magdalene College, was re-elected Vice-Chancellor of the University for a second year.

It is proposed to confer the degree of Doctor of Letters, *honoris causâ*, upon Commendatore Giacomo Boni, director of the excavations on the Forum and the Palatine.

The registrary reports that the matriculation this term brings the number of new students for the academic year 1912–13 up to 1200. In the last academic year the numbers were 1156.

Mr. R. Assheton, of Trinity College, and Mr. L. Doncaster, of King's College, have been approved by the general board of studies for the degree of Doctor of Science.

Oxford.—A summer course in advanced practical organic chemistry, with demonstrations, will be held at Queen's College, on August 1–30, by Mr. F. D.

Chattaway, F.R.S. The class is open to students who are not members of the University.

THE new college buildings of Bedford College for Women at Regent's Park, London, N.W., are to be opened by the Queen on July 4, at 3 p.m.

VACATION courses for instrument-makers and glass-blowers will be held at the University of Leyden from August 21 to September 4. Particulars of the courses can be obtained from the director, Prof. H. Kamerlingh Onnes, or the general secretary, Dr. C. A. Crommelin.

THE Commemoration Day proceedings at Livingstone College on June 7 will be the celebration by the college of the Livingstone centenary. The reception of the special delegates and visitors by the principal will be from 3 to 3.30 p.m., and afterwards a number of addresses will be given and an exhibition held.

AT the end of the present academic year Cornell University, N.Y., will lose the services of Prof. H. H. Norris, who has occupied its chair of electrical engineering since 1905, and has been head of the department since 1909. He is resigning in order to undertake editorial work in connection with *The Electrical Railway Journal* and *The Electrical World*.

THE following appointments have been made to the faculty of the new school of technology in connection with Johns Hopkins University, Baltimore:—Prof. C. C. Thomas, of the University of Wisconsin, to the chair of mechanical engineering; Prof. C. J. Tilden, of the University of Michigan, to the chair of civil engineering; and Prof. J. B. Whitehead, hitherto professor of applied electricity in Johns Hopkins University, to the chair of electrical engineering.

AN influentially signed memorial has been sent to Lord Haldane, in his capacity of Chancellor of the University of Bristol, directing attention to the circumstances in which Mr. R. P. Cowl, formerly professor of English literature, was removed from the University of Bristol in 1910. The signatories point out that it appears that a grave injustice may have been committed, and ask for a full investigation of the case. In the first list of signatories there are many distinguished names, including the following men of science:—Prof. W. Ridgeway, Sir Bertram Windle, Profs. R. H. Yapp, J. A. Green, W. M. Travers, P. F. Frankland, Leonard Hill, William Bullock, J. Adams, Gisbert Kapp, F. W. Burstall, W. M. Bayliss, E. W. Hobson, and F. R. Japp.

IT is announced in *Science* that Mrs. G. W. Hooper, of San Francisco, has transferred to the University of California 200,000*l*. for the establishment of an institute of medical research. We learn from the same source that the late Prof. Louis A. Duhring, formerly professor in the University of Pennsylvania, in his will disposes of an estate valued at about 100,000*l*. The will creates a trust fund of 5000*l*., the income of which is to be used for the benefit of the department of cutaneous medicine, and it gives the University of Pennsylvania Hospital 10,000*l*. for the establishment of free beds in which cutaneous, cancerous, and allied diseases shall be treated and studied. After a number of private bequests have been made, the residue of the estate is to be given to the trustees of the University of Pennsylvania, and applied to the treatment of cutaneous diseases and their study.

THE Apprenticeship and Skilled Employment Association has issued its seventh annual report. The work of the association is, among other matters, to watch over the interests of juveniles so far as they are affected by fresh legislation. During the year under review the association has inquired into the hours of employment of van and errand boys, and the conditions of employment of boy clerks in the Civil Service; and representatives of the association have given evidence before the Royal Commission on the Civil Service. It is satisfactory to know that the London County Council has adopted a suggestion made a short time ago by the association that attendance at continuation classes should be made a condition of employment of their laboratory monitors. These lads on leaving the council's service have, as in the past, been referred to the association, and have in almost every case been successfully placed. The report gives further interesting evidence that there is a growing disposition among public bodies to make use of the services of the association in the matter of boys and girls under their supervision.

THE issue of *The Fortnightly Review* for June includes an article on vocational education by Mr. Cloudesley Brereton. The whole spirit of vocational education is, he maintains, that the manual work and crafts with which it deals should not be taught mechanically, or as a mere rule of thumb, but should be used as veritable instruments of culture. In London, vocational education has led, apart from the polytechnic movement and the great extension of trade schools, to the conversion of the higher elementary schools into central schools, to which has been given a definite bias for the preparation of the pupils for an industrial or commercial life; while the work in the infant schools and lower grades of the elementary schools is every day becoming more concrete and constructive. It is to be hoped, Mr. Brereton thinks, that any scheme of national education will immensely enlarge the facilities for vocational education, and be the means of bringing the university into closer touch with the business world and the locality of which it should be the spiritual and intellectual inspiration. One thing is, he says, at least certain: we shall never gain the full confidence of the business world and the working classes until we can show that education is practical, *i.e.* that it has an economic value; while if we are to retain the confidence of those who believe in the spiritual side of education, we must likewise hold fast to its humanistic ideals. Vocational education in the widest sense means the working out of the combination of these ideals.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 29.—Sir Archibald Geikie, K.C.B., president, in the chair.—Prof. A. B. **Macallum**: *Acineta tuberosa*: a study on the action of surface tension in determining the distribution of salts in living matter. In previous investigations it was found that the salts demonstrated microchemically to occur in the living cell were not uniformly diffused but were condensed or "localised" at points in its cytoplasm, or at parts of its surface. Amongst such salts were the compounds of potassium, which are very soluble and are not known to form precipitates in nature. It was concluded that some other force than simple osmotic pressure was concerned in this distribution of the salts, especially in the cases where the condensations were in those portions of the cell surface where, from the deformation observed, it was inferred that a lowering of surface tension was involved. The explanation advanced was that surface tension was the factor primarily concerned in these condensations. Two years ago an investigation of the distribution of potassium salts in *Acineta tuberosa*, a marine Suctorian Protozoan, gave results which appear to place the matter beyond doubt. It would seem, from further investigations, that surface tension not only determines the condensations in the films and elsewhere in the organisms, but also maintains these condensations against the forces of diffusion.—Sir David **Bruce**, Majors D. **Harvey** and A. E. **Hamerton**, and Lady **Bruce**: Morphology of various strains of the trypanosome causing disease in man in Nyasaland. IV., The Mzimba strain.—Helen L. M. **Pixell**: Notes on *Toxoplasma gondii*.—J. C. F. **Fryer**: An investigation by pedigree breeding into the polymorphism of *Papilio polytes*, Linn.—Dr. S. **Russ** and Dr. Helen **Chambers**: The action of radium rays upon the cells of Jensen's rat sarcoma.

Physical Society, May 16.—Prof. C. H. Lees, vice-president, in the chair.—Dr. W. **Makower** and Dr. S. **Russ**: Some experiments to detect β rays from radium A. When an atom of radium A disintegrates an α particle is expelled which carries with it two positive atomic charges. At the same time the radium B atom formed recoils with a single positive charge. To explain this it is necessary to suppose that three negative electrons are expelled during the process. If these are emitted with a high velocity they should appear as β rays capable of detection; or they might consist of a slowly moving δ radiation which would escape such detection. The experiments, made by both methods in the hope of detecting β rays from radium A, failed to reveal any such radiation.—Dr. J. **Robinson**: Dust figures. The ripple formation in Kundt's tube was explained by W. König in 1891. His theory was based on the hydrodynamical forces between two particles in a stream. Certain measurements on dust figures produced by an electric spark have shown that these figures also can be explained in a similar way to the Kundt's tube figures. Cook suggested that viscosity must be introduced in order to account for the formation of ripples. The author shows that it is possible to account for ripple formation without introducing viscous forces at all. In the case of the Kundt's tube figures there is a variation of velocity of the air from a node to an antinode, which produces a variation in the forces, and this causes the powder to lose its uniformity of distribution and to form ripples. The necessary constraints for the ripples are forthcoming without the introduction of viscosity.—Dr. **Haworth**: Vibration galvanometer design. (1) The maximum amount of power available for vibrating the moving system of a vibration galvanometer of the moving-coil type is $V^2/4R$. As the frequency of the instrument is raised the losses increase rapidly, so it is an advantage to be able to increase the useful power input per unit voltage; the resistance of the instrument must be decreased. This can be done in a galvanometer of the Duddell type by leading the current in and out at the bottom bridg and short-circuiting the wires at the top bridge, an it results in an increase of sensibility. (2) Owing to the losses in the moving system increasing at a greater rate than the first power of the frequency, and because the frequency of the system increases at a slower rate than the reciprocal length of the string on account of the mass of the mirror, the flux density must be increased as the frequency increases. As the losses are low at low frequency and the mass of the mirror is not large, then, compared with the mass of the wire, the flux density required is moderate; but at high frequencies the flux density required is large. To obtain this result economically it is convenient to make the depth of the poles small compared with the maximum length of the wires. (3) A combination of (1) and (2) makes a satisfactory instrument with a much flatter voltmeter-sensibility-frequency curve than obtained usually.

Dublin.

Royal Dublin Society, May 20.—Prof. James Wilson in the chair.—W. J. **Hartley**: A violet colouring matter and its production by a certain bacterium. The bacterium was isolated from the water supply of a creamery. The cultural characters resemble those of both *Bacterium violaceus* and *B. ianthinus*, as described by Macé. The colour was best produced on potato. Colour was not produced at 37° C., in the absence of air, or in the absence of more moisture than was sufficient for the growth of the organism. In artificial media colour was produced in the absence of peptone. The colouring matter extracted with alcohol is an amorphous blue-black, solid, without surface reflection. A weighed quantity was dissolved in alcohol, and the absorption spectra were examined optically and photographically at various dilutions. The spectra extended from $\lambda 670$ in the red to $\lambda 227$ in the ultra-violet. At the greatest dilution only one absorption band was observed, starting at $\lambda 6430$, and extending towards, but not further than, $\lambda 5000$; the ultra-violet absorption is general, with no indication of bands. This spectrum differs from that of the dyes, such as Hoffmann's violet, and from the spectra of violet colouring matters extracted from natural sources by Schneider, Moseley, Molisch, Krukenburg, and Lecoq de Boisbaudran. The chemical reactions of the solution resemble those of some natural violet colouring matters. It is an oxygenated substance which, in the presence of light, oxidises substances such as alcohol.—Rev. Henry V. **Gill**: The effect of a low potential electric current on photographic plates. The object of this communication was to describe some results which had been obtained from experiments on photographic plates. There is a great deal of uncertainty concerning the nature of the changes which take place in the sensitive surface of such plates when they are exposed to the action of light and other influences. Many physicists have studied the effect of passing electric sparks over the surface of dry photographic plates. On development a record of the path traversed by the discharge is obtained. The blackening of the plate is in great part due to the luminosity accompanying the discharge, and it is consequently difficult to determine the part played by the current as distinct from the luminosity of the spark. The discharge was non-luminous, and of comparatively low voltage, from 200 to 400 volts. The results obtained show that the effect of such a current on sensitive plates is complicated, and depends to a great extent on the nature of the terminals placed at the surface of the plate, between which the discharge takes place. The ions coming from the positive terminal seem to play the chief part in the reaction. When, for example, copper is employed as positive terminal, a considerable region of the plate surrounding the point of contact is found on development to be blackened; on the other hand, when platinum is used no blackening of the plate is produced. Silver and other metals produce characteristic effects. The effect at the negative terminal is very much less and does not depend on the nature of the terminal.

Paris.

Academy of Sciences, May 26.—M. F. Guyon in the chair.—Emile **Picard**: Concerning the recent meeting of the International Association of Academies. A short account of the subjects discussed at the meeting at St. Petersburg.—Paul **Appell**: The Hermite polynomials $U_{m,n}$ and their analogues connected with spherical functions in hyperspace.—P. **Chofardet**: Observations of the Schaumasse comet, 1913*a*, made at the Observatory of Besançon with the bent equatorial. Positions are given for May 21 and 24. On

May 24 this comet appeared as a circular nebulosity 1·5′ diameter, magnitude between 8 and 9. There was a diffuse nucleus but no tail.—Nicolas **Kryloff**: Some properties of integral equations with non-symmetrical nucleus.—J. **Tamarkine**: The problem of the development of an arbitrary function in a Sturm-Liouville series.—W. F. **Osgood**: An extension of a theorem of Weierstrass and on a restriction of another theorem by the same author.—M. **d'Ocagne**: The general application of the method of aligned points to problems which reduce themselves to solutions of spherical triangles.—Th. **Got**: The equivalence of certain indefinite ternary quadratic forms of the same genus.—L. **Décombe**: The viscosity of the atom. In the absorption of light and in certain abnormal dielectric phenomena an explanation is found in a certain viscosity term, proportional to the velocity, and regarded hitherto as an empirical term. An attempt is made to connect this with the fundamental principles of mechanics.—A. **Tian**: The relation between light energy and photochemical action. An examination of the conditions under which the law of proportionality between photochemical effect and light absorption is verified.—L. **Chaumont**: The theory of apparatus serving for the study of elliptically polarised light.—R. **Fortrat**: The normal magnetic triplet and Preston's rule.—Jacques **Carvallo**: The electrical conductivity of pure ether. An arrangement is described securing the perfect isolation of the electrodes. Under a constant difference of potential of 1144 volts the conductivity diminished slowly for eight days, after which it remained constant. The extremely small residual conductivity observed is attributed to traces of impurities.—Keivin **Burns**: Interference measurements of wave-lengths in the iron spectrum. Employing the methods of Buisson and Fabry, interference measurements of the iron lines have been extended from wave-length 6500 to 8824.—Félix **Bidet**: The displacement limit of monoethylamine by ammonia gas. A study of the influence of temperature and pressure on the equilibrium limit and on the velocity of the reaction.—Georges **Charpy** and André **Cornu**: The separation of graphite in alloys of iron and silicon.—A. **Recoura**: The instability of ferric fluosilicate and its spontaneous transformation into another double fluoride of silicon and iron.—J. B. **Senderens** and J. **Aboulenc**: The ester salts derived from octanol by the method of the authors; observations on the principle of this method. The application of the use of small quantities of sulphuric acid (2 per cent. to 3 per cent.) in the catalytic formation of esters.—Georges **Dupont**: The catalytic hydrogenation of the acetylene γ-glycols in presence of palladium black. Acetylene glycols of the fatty series treated with hydrogen and palladium black are more highly reduced than when platinum black is used. A mixture of a saturated glycol, alcohol, and hydrocarbon is produced. The difference between the two catalytic agents is still more marked with the aromatic acetylenic glycols, platinum giving the saturated glycols only, palladium the hydrocarbons.—A. **Guyot** and J. **Martinet**: The condensation of the primary and secondary aromatic amines with the mesoxalic esters. Synthesis in the indole series.—Jean **Nivière**: The action of α-monochlorohydrin and epichlorohydrin upon the monosodium derivative of glycerol.—Marcel **Lantenois**: Some new properties of carbon tetraiodide and its estimation in presence of iodoform. Carbon tetraiodide reacts with an aqueous solution of silver nitrate giving carbon dioxide, nitric acid, and silver nitrate; iodoform, with the same reagent, gives carbon monoxide, silver iodide, and iodate and nitric acid. When aqueous solution of silver nitrate is allowed to act upon a mixture of iodoform and carbon tetraiodide the proportion of carbon monoxide and dioxide evolved serves accurately to indicate the composition of the mixture.—Henri **Pottevin**: Cholera toxin and antitoxin.—A. **Besredka**: Study of the tubercle bacillus. A description of a good liquid medium for the culture of the tubercle bacillus. The growth after twenty-four hours in this liquid is as abundant as that of an ordinary microbe such as streptococcus. Bovine and human bacilli give distinctive growths in this medium.—Mme. A. **Hufnagel**: A periœsophagian organ observed in two Lepidoptera.—Em. **Bourquelot** and Em. **Verdon**: The use of increasing proportions of glucose in the biochemical synthesis of β-methylglucoside. The influence of the glucoside formed on the arrest of the reaction.

CALCUTTA.

Asiatic Society of Bengal, May 7.—D. **Prain** and I. H. **Burkill**: A synopsis of the Dioscoreas of the Old World, Africa excluded, with descriptions of new species and of varieties. Diagnoses of new species and varieties are given, as well as a key to the genus.—H. M. **Chibber**: Variations in the flowers of *Limnanthemum indicum*, Thwaites. Four hundred and fifty-seven flowers were examined and the variations observed are given in tabular form.—Maude L. **Cleghorn**: Notes on pollination of *Colocasia antiquorum*. The paper records some observations on the pollination of the Indian Kachu, and compares it with the process known in the European cuckoo-pint (*Arum maculatum*).—Jitendra Nath **Rakshit**: Double compounds of mercuric oxide with compounds containing ketonic radical. A compound is described of the formula $C_3H_6O, 3HgO$.

BOOKS RECEIVED.

British Museum (Natural History). Catalogue of the Plants collected by Mr. and Mrs. P. A. Talbot in the Oban District, South Nigeria. By Dr. A. B. Rendle, E. G. Baker, H. F. Wernham, S. Moore, and others. Pp. x+157+17 plates. (London: The Trustees of the British Museum; Longmans and Co. and others.) 9*s.*

British Museum (Natural History). Catalogue of the British Species of Pisidium (Recent and Fossil) in the Collections of the British Museum (Natural History), with Notes on those of Western Europe. By B. B. Woodward. Pp. ix+144+xxx plates. (London: The Trustees of the British Museum; Longmans and Co. and others.) 10*s.* 6*d.*

Die biologischen Grundlagen der sekundären Geschlechtscharaktere. By Drs. J. Tandler and S. Grosz. Pp. 169. (Berlin: J. Springer.) 8 marks.

Qualitative Analyse vom Standpunkte der Ionenlehre. By Dr. W. Böttger. Dritte Auflage. Pp. xvii+565+plate. (Leipzig: W. Engelmann.) 11.20 marks.

A Text-Book on Trade Waste Waters: their Nature and Disposal. By Drs. H. M. Wilson and H. T. Calvert. Pp. xii+340. (London: C. Griffin and Co., Ltd.) 18*s.* net.

Preliminary Chemistry. By H. W. Bausor. Pp. 106. (London: W. B. Clive.) 1*s.* 6*d.*

Man and his Forerunners. By Prof. H. v. Buttel-Reepen. Translated by A. G. Thacker. Pp. x+96. (London: Longmans and Co.) 2*s.* 6*d.* net.

Researches on Irritability of Plants. By Prof. J. C. Bose. Pp. xxiv+376. (London: Longmans and Co.) 7*s.* 6*d.* net.

Egyptian Government. Ministry of Finance. Survey Department. Report on the Work of the Laboratories and of the Assay Office during 1912. By A. Lucas. Pp. 28. (Cairo: Government Press.) 5 P.T.

Electric Wiring. By Prof. W. C. Clinton. New edition. Pp. viii+197. (London: J. Murray.) 2*s.*

Unsere Kohlen. By P. Kukuk. Pp. x+120+plate. (Leipzig: B. G. Teubner.) 1.25 marks.

Problèmes de Mécanique et Cours de Cinématique. By Prof. C. Guichard. Pp. 156. (Paris: A. Hermann et Fils.) 6 francs.

Leçons de Thermodynamique. By Dr. M. Planck. Translated by R. Chevassus. Pp. 310. (Paris: A. Hermann et Fils.) 12 francs.

Western Australia. Meteorology of Australia. Commonwealth Bureau of Meteorology. Results of Meteorological Observations made in Western Australia during 1908. Pp. 130+maps. (Perth, W.A.: F. W. Simpson.)

Guide-Annuaire du Gouvernement Général de Madagascar et Dépendances. Année 1913. Pp. viii+788. (Tananarive: Imprimerie Officielle.)

Die Züchtung kolonialer Gewächse. Edited by C. Fruwirth. Pp. xix+184. (Berlin: P. Parey.) 9 marks.

Grundriss der Kristallographie. By Dr. G. Linck. Dritte Auflage. Pp. viii+272+iii plates. (Jena: G. Fischer.) 11.50 marks.

Das Pflanzenreich. Edited by A. Engler. 59 Heft (iv+251). Hydrophyllaceæ. By A. Brand. (Leipzig: W. Engelmann.) 10.60 marks.

An Elementary Treatise on Calculus. By W. S. Franklin, B. MacNutt, and R. L. Charles. Pp. x+253+41. (S. Bethlehem, Pa.: The Authors, Lehigh University.) 2 dollars.

Plants and Their Uses. By F. L. Sargent. Pp. x+610. (New York: H. Holt and Co.)

The Wanderings of Animals. By Dr. H. Gadow. Pp. vi+150+maps. Wireless Telegraphy. By Prof. C. L. Fortescue. Pp. vi+143. Beyond the Atom. By Prof. J. Cox. Pp. 151. Submerged Forests. By C. Reid. Pp. 129. Bees and Wasps. By O. H. Latter. Pp. vi+132. (Cambridge Manuals of Science and Literature.) (London: Cambridge University Press.) 1s. net each.

A Junior Course of Arithmetic. By H. S. Jones. Pp. ix+224. (London: Macmillan and Co., Ltd.) 1s. 6d.

Practical Bacteriology, Microbiology, and Serum Therapy (Medical and Veterinary). By Dr. A. Besson. Translated and adapted from the fifth French edition by Prof. H. J. Hutchens. Pp. xxx+892. (London: Longmans and Co.) 36s. net.

Liquid Steel: its Manufacture and Cost. By D. Carnegie, assisted by S. C. Gladwyn. Pp. xxv+520+x plates. (London: Longmans and Co.) 25s. net.

The Bodley Head Natural History. Vol. i., British Birds. Passeres. By E. D. Cuming. Pp. 120+iii plates. (London: J. Lane.) 2s. net.

DIARY OF SOCIETIES.

THURSDAY, JUNE 5.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: The Origin of Mammals: Dr. R. Broom.—The Fossil Floras of the Wyre Forest, with Special Reference to the Geology of the Coalfield and its Relationships to the Neighbouring Coal Measure Areas: Dr. E. A. Newell Arber.

ROYAL INSTITUTION, at 3.—Recent Chemical Advances. III. The Structure of Crystals: Prof. W. J. Pope.

LINNEAN SOCIETY, at 8.—A Contribution to the Flora and Plant Formations of Kinabalu and the Highlands of British North Borneo: Miss L. S. Gibbs.—The Hydrophilidæ: Histeridæ of the Percy Sladen Expedition to the Seychelles: H. Scott.—Marine Algæ from the Indian Ocean: Mme. Weber van Bosse.—Myrmeleonidæ from the Indian Ocean: J. G. Needham.—Rhynchota of the Seychelles: 1. Heteroptera: W. L. Distant.—Mystropetalon, Harv.: Prof. R. J. Harvey Gibson.

FRIDAY, JUNE 6.

ROYAL INSTITUTION, at 9.—Reflection and Refraction of Light as Concealing and Revealing Factors in Sub-aquatic Life: F. Ward.

GEOLOGISTS' ASSOCIATION, at 8.—Palæolithic Man in the Thames Valley: H. Dewey.

SATURDAY, JUNE 7.

ROYAL INSTITUTION, at 3.—Radio-activity. III. The Radio-active State of the Earth and Atmosphere: Prof. E. Rutherford. (The Tyndall Lectures.)

MONDAY, JUNE 9.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Across Southern Jubaland to the Lorian Swamp: I. N. Dracopoli.

TUESDAY, JUNE 10.

ROYAL ANTHROPOLOGICAL INSTITUTE (Royal College of Surgeons, Lincoln's Inn Fields, W.C.), at 2.30.—Racial Migrations in Africa: Sir H. H. Johnston.

WEDNESDAY, JUNE 11.

GEOLOGICAL SOCIETY, at 8.—Certain Upper Jurassic Strata of England: Dr. H. Salfeld.—The Volcanic Rocks of the Forfarshire Coast and their Associated Sediments: A. Jowett.—Metamorphosed Sediments between Machakos and Lake Magadi (British East Africa): J. Parkinson.

THURSDAY, JUNE 12.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Recent Researches on the Palatine in Relation to Geology, Ethnology, and Physics: Commendatore Boni.—The Trypanosomes causing Dourine (Mal de Coit or Beschälseuche): Dr. B. Blacklock and Dr. W. Yorke.—The Growth and Sporulation of the Benign and Malignant Tertian Malarial Parasites in the Culture Tube and in the Human Host: J. G. Thomson and D. Thomson.

FRIDAY, JUNE 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—Note on the Genus Pseudomalaxis, Fischer, and Descriptions of a New Species and a New Subgenus: Marqués de Monterosato.—Note on the Freshwater Mollusca found with *Unio Auriculatus*, Spengl, at Barn Elms, Surrey: A. S. Kennard and B. B. Woodward.—The Land Mollusca of the Kermadec Islands: Tom Iredale.—Definitions of Further New Genera of Zonitidæ: G. K. Gude.

PHYSICAL SOCIETY, at 8.—Some Experiments on Tinfoil Contact with Dielectrics: G. E. Bairsto.—A Method of Measuring the Pressure of Light by Means of Metal Foil: G. D. West.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, JUNE 12, 1913.

SEEDS OF FLOWERING PLANTS.

Studies in Seeds and Fruits: an Investigation with the Balance. By H. B. Guppy. Pp. xii + 528. (London: Williams and Norgate, 1912.) Price 15*s*. net.

IN this work we find the results of Mr. Guppy's investigations on the seeds of several flowering plants. The investigations seem to have been prompted by a statement by Goebel to the effect that the biology of the ripening fruit has hitherto scarcely received attention, and a further statement by Pfeffer that the means by which the power of resistance to drying is gained and the changes which cause its loss are quite unknown.

Such subjects are investigated as the permeability and impermeability of seeds, their hygroscopicity, shrinking and swelling, their homologies, their dehiscence, the proportions of the different parts of the fruits, the relation between the number of seeds and the size and weight of the fruit, the abortion of ovules and the failure of seeds, seed coloration, the weight of the embryo, the rest period of seeds, and finally "the cosmic adaptation of the seed." It is impossible in the space of a short review to give any adequate ideas of the whole of the author's investigations.

From the beginning his "usual plan of following indications was adopted, forming crude hypotheses as [he] went along, and dropping them as soon as they had lost their usefulness. Many points, of course, remained undetermined," and Mr. Guppy only offers "a contribution to the study of a difficult but highly interesting subject." In the cases investigated it was found that all the ovules begin to respond to fertilisation; but it frequently happened, as in Arenaria, Stellaria, Primula, Scilla, and Iris, that only two-thirds of the original complement of ovules developed into mature seeds. In several legumes a marked constriction results from the abortion of the ovules, the degree of constriction being determined by the number of contiguous failures.

Special stress is laid on seedless fruits, where the fruit develops under the stimulus of pollination but the seeds fail. The author's results, so far as they go, are full of interest, and he fully realises that much more must be determined before it is possible to draw safe generalisations. To some readers the book will appear discursive and perhaps unconvincing, and without doubt the salient features of the work could have been expressed in fewer words; but throughout the book one sees the unprejudiced observer at work, and many of the results obtained are both interesting and important. Its very discursiveness has a kind of charm, and there is an occasional incisiveness which is refreshing, as in the following:—

"Lord Avebury would regard such persistently functionless ovules as carrying us back to the time when . . . all the ovules developed into seeds. Prof. Bower holds a similar view with reference to the abortive ovules in the beak of a fruit of *Anemone nemorosa*. . . It should, however, be pointed out that this would not follow if we accept the standpoint taken by Dr. Goebel . . . that functionless organs in plants are not necessarily the vestiges of former completely developed ones, and that many more primordia are laid down than become functional."

Each chapter is supplied with a full and useful summary, and there is an excellent index. It is refreshing to find that Mr. Guppy is not content with vaguely referring to authorities, but supplies the name of the work and the volume and the page of the authors he refers to. In this last respect, as well as in some others, his methods are worthy of being adopted by more pretentious writers.

ENGINEERING SCIENCE.

Mécanique Appliquée. By Prof. John Perry. Ouvrage traduit sur la Neuvième Edition Anglaise par E. Davaux. Avec des additions et un appendice sur la mécanique des corps déformables by E. Cosserat and F. Cosserat. Tome Premier. L'Energie Mécanique. Pp. vii + 398. (Paris: A. Hermann et Fils, 1913.)

THERE must surely be few text-books about which such conflicting opinions are held as this well-known book on applied mechanics by Prof. John Perry. One of these opinions, favourable to the book, is held by a majority of teachers of engineering science and by almost all engineers. The other, which is equally unfavourable, is confined to a minority of teachers—doubtless the "academic persons" to whom the author so often refers. There must be something fundamental, some conflict of principle, which can produce so wide a difference of opinion between persons equally competent to judge. We are aided in arriving at the nature of this conflict by the fact that engineers outside the colleges are almost universally in its favour; as they are, indeed, of each of the author's text-books relating to engineering subjects. Perhaps a parable may be admitted. We picture two travellers desirous of arriving at the same destination, one of them alert to have all the precise formalities of the journey carefully observed, and the other careless of by-laws, and only careful that he shall arrive at his destination by a road which, while reasonably rapid, shall not absorb his every mental activity until such time as the destination is reached.

Put crudely, it is the old choice between devotion to the "means" and devotion to the "ends." Engineers almost always care more for the latter than for the former, being well aware that their route must ever be subject to other than purely abstract considerations. Unless engineering "instinct" points along some reasonably converging line, nothing will persuade them that the "academic" path is the true one. But this is stated as the point of view of English engineers. How does the matter stand with, let us say, the German and the French? This question is to some extent answered by the interesting fact that, although a German edition of Perry's "Applied Mechanics" was published five years ago, it is only in 1913 that a French translation is appearing.

For this purpose the book has been divided into two volumes, of which the first has now been published with a preface by MM. E. and F. Cosserat. After describing generally the method of the book, the writers of the preface remark: "C'est cette méthode, quelque peu hérétique dans notre pays, qui a été dévelopée avec un très grand talent par M. John Perry dans le livre remarquable que nous présentons aux lecteurs français."

The French mind is logical and is attracted by logical method; their engineering is a far more highly refined product than the English—judged, that is, from the scientific point of view. The Germans are capable of as much precision as the French, but are more desirous of taking high place as capable technicians, and inclined, therefore, to study the methods which successful English engineers have adopted. How successful that study has been there are many instances to show. It has occasionally happened, indeed, that German method has far outreached the English, so that the less sturdy opinion in this country has felt there is cause for pessimism, notwithstanding that such industries are rarely the most productive of income, or the least risky in respect of capital.

Germany is willing to learn from England because she values the "fait accompli." France, looking more to abstract considerations, does not think she has much to learn from English writers, and refrains, therefore, from a zealous study of them. If we take, for example, one of the problems dealt with in this book—that of the proper design of springs—we find English engineers relying chiefly on rule-of-thumb methods, whilst the most carefully refined analysis of the subject appeared in French many years ago. Why, therefore, should the French look to us for guidance? Furthermore, it often happens that English writings on the scientific study of engineering work are unknown abroad. A Swedish engineer recently explained to the writer that, in consequence of the different way in which the bookselling business is managed abroad, English technical books are sold to a very small extent, and that ninety-nine out of a hundred foreigners get the impression that by far the greater progress in science and theoretical engineering comes from Germany. The translation of Prof. Perry's book into French will help to eradicate this impression, and we congratulate ourselves, as well as Prof. Perry, upon this sign of appreciation of English engineering science.

H. E. W.

PALÆOLITHIC MAN AND BRONZE AGE MAN.

Palaeolithic Man and Terramara Settlements in Europe. By Dr. Robert Munro. Pp. xxiii + 507 + 74 plates. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson, 1912.) Price 16*s*. net.

LAST year Dr. Robert Munro founded a lectureship in the University of Edinburgh to popularise the results of research in anthropology and prehistoric archæology, which have recently become so important and interesting. He himself gave the inaugural course, and these lectures have now been published in a copiously illustrated volume, which will be welcomed equally by the general reader and the student. In the first part Dr. Munro summarises our present knowledge of Palæolithic man in Europe, while in the second part he gives a more detailed account of the Terramara settlements of the Po valley in northern Italy, to which he himself has paid special attention. In all cases the readable text is accompanied by ample references to the literature of the subject.

Dr. Munro does well at the outset to emphasise the fact "that the principles and laws which govern the rest of the organic world, past and present, are equally applicable to Man," and he thus begins with an interesting sketch of organic evolution. He points out that man's career was an entirely new departure owing to his superior mental endowments, and he argues that this superiority was primarily due to the attainment of the erect attitude. There are, however, still many difficulties in accepting the latter opinion, and more facts are needed before it can be satisfactorily discussed.

In the admirable review of the discoveries of Palæolithic man and his handiwork, Dr. Munro makes several interesting suggestions, and formulates judgments on some of the subjects of controversy. He accepts the French classification of the successive periods as applicable to England, and concludes that the Chellean is not pre-Glacial, but is referable to the middle of the Pleistocene age. He discusses the human skeleton embedded in ochre found by Buckland in the Paviland cave, Glamorganshire, and points out that it is paralleled by similar burials of a late Palæolithic period in France and Moravia. He considers that the importance of the Engis skull has been exaggerated, and concludes that the Tilbury man cannot be later than the beginning of the Neolithic period. He gives reasons for supposing that the early Neolithic immigrants to western Europe may have lived for some time with the Palæolithic peoples whom they found there.

The description of the Terramara settlements, which occupies nearly 200 pages, forms an exhaustive work of reference on a subject on which Dr. Munro speaks with special authority. More than 100 of these large flat mounds in the valley of the Po have now been examined, and it seems clear that they are all referable to the Bronze age. They are generally quadrangular in shape, and their average superficial area is about seven acres. Implements, seeds and fruits, and bones of the animals used for food are so numerous that a very fair idea of the life of the inhabitants can be obtained, and it is evident that they were occupied with many industries. They made their own bronze implements and ornaments, worked also in bone and terracotta, and must have woven much cloth, judging by the extraordinary variety and abundance of spindle-whorls and loom-weights. Their pottery is especially artistic, and the peculiar horned appendages fixed to the tops of the handles have not been found outside the area of the Terramare and certain districts influenced by the civilisation of their inhabitants.

MATHEMATICAL TEXT-BOOKS.

(1) *Matematica Dilettevole e Curiosa.* By Ing. Italo Ghersi. Pp. viii + 730. (Milano: Ulrico Hoepli, 1913.) Price 9.50 lire.

(2) *New Analytic Geometry.* By Prof. P. F. Smith and Prof. A. S. Gale. Pp. x + 342. (Boston and London: Ginn and Co., n.d.) Price 6*s.* 6*d.*

(3) *Experimental Mensuration: An Elementary Text-Book of Inductive Geometry.* By H. Stanley Redgrove. Pp. xvii + 328. (London: W. Heinemann, 1912.) Price 2*s.* 6*d.* net.

(4) *Geometrical Optics.* By A. S. Percival. Pp. vii + 132. (London: Longmans, Green and Co., 1913.) Price 4*s.* 6*d.* net.

(5) *Problèmes d'Analyse Mathématique.* By Prof. E. Fabry. Pp. 460. (Paris: A. Hermann et Fils, 1913.) Price 12 francs.

(6) *Leçons sur l'Intégration des Equations Différentielles aux Dérivées Partielles.* By Prof. M. V. Volterra. Pp. ii + 83. (Paris: A. Hermann et Fils, 1912.) Price 6 francs.

(1) THIS collection of mathematical paradoxes should be of interest to a large circle of readers. It is remarkably comprehensive, occupying more than seven hundred closely printed pages, is profusely illustrated, and is published at a very reasonable price. Those who are acquainted with Mr. Rouse Ball's work will find much in these pages with which they are already familiar, but there will be very few who will not discover something that is new and surprising. In addition to the standard problems of antiquity—the squaring of the circle, the trisection of an angle, and the duplication of the cube—there are elaborate sections on arithmetic, algebra, geometry, and mechanics. There are problems on shunting, map-making, perpetual motion, trammells, constructions with limited instruments, probability, magic squares, boomerangs, draughts, chess, and many other themes of a popular character. It is, however, impossible to give any detailed account of so miscellaneous a work; enough has, perhaps, been said to show that there is abundant material to while away any number of idle hours.

(2) It is gradually becoming recognised that the practice in elementary text-books of restricting cartesian geometry to straight lines and curves of the second degree gives the student a narrow idea of the power and generality of analytic methods. For ordinary purposes a course of the character set out in the volume before us is, in our view, far more valuable than that given in most English text-books. Intricate properties of conics and systems of conics, homogeneous coordinates, invariants, &c., are omitted, and space is thus obtained for curves of higher degree and the elements of three-dimensional geometry. There is an excellent collection of examples, few of which demand from the student any high degree of analytic skill.

(3) The author gives us, in the present work, a distinctly original text-book on geometry. He is in sympathy with the principles laid down in the circular issued by the Board of Education, and, in addition, contends that this subject loses most of its educational value if it is not united from the first with mensuration and trigonometry. The trigonometrical ratios are accordingly introduced in the second chapter, and applications are made at every convenient opportunity. With the exception of a few of the chief geometrical theorems, which are mainly derived by inductive processes, there is no formal geometry, and practically all

the examples are of a numerical type. In our opinion, a text-book such as this is more useful to the teacher than the student; we are inclined to think that it is too diffuse for the latter, but it contains so much that is suggestive and stimulating that few teachers would not gain from using it to supplement and guide their class-work. A good feature of the book is the inclusion of descriptions of calipers, verniers, diagonal and plain scales, the micrometer screw-gauge, the spherometer, the planimeter and opisometer, methods of measurement of volumes, the construction and use of a scale of chords, and Simpson's method for evaluating areas. There is also an appendix on the use of duodecimals.

(4) The author writes primarily for medical students, but there is no reason why his work should not be equally suitable for any student of elementary physics; very small demands are made on the mathematical capacity of the reader. The fundamental results are established at such length, and so clearly, that they should be intelligible to all. Great importance is attached to the use and meaning of algebraic signs; as soon as this idea is grasped, the formulæ employed assume simple forms. The text-book is purposely practical rather than academic; there is, for example, little mention of the general mathematical theory of systems of lenses or properties of the paths of rays in heterogeneous media. But the author supplies an abundance of excellent illustrations and exercises which will give the student a far better grasp of the principles of the subject than he would gain from an abstract mathematical treatise.

(5) This collection of about 270 problems (many of which contain several parts), selected from recent French examination papers, is divided into twelve sections: integration, multiple integrals, analytic functions and curvilinear integrals, differential equations, plane curves, skew curves and surfaces, asymptotic lines and lines of curvature, ruled surfaces, partial differential equations, geometrical applications of partial differential equations, total differentials, elliptic functions. The statement of the problems occupies one-seventh of the book; the rest is devoted to their solution. Where we have tested them we have found them sufficiently clear and detailed for any student of average ability. We have no hesitation in saying that this collection will be of real value to students and teachers alike; and its utility will be still further increased if the publishers are able to issue the problems in a separate volume.

(6) These lectures, which were published a few years ago, are now re-issued with a few notes and corrections. Pressure of other work has prevented the author from attempting to re-write them in the light of the very considerable progress that has been made in the last six years, but the addition of numerous bibliographical references will enable the reader, if inclined, to see what has been done. In a comparatively small compass the author covers a wide range of theory. In dealing with the bearing of the theory of differential equations upon physical problems, he investigates the elliptic, hyperbolic, and parabolic types with a view to the interpretation and application of the many-valued form of solution and the relation to multiply-connected domains.

OUR BOOKSHELF.

Myths of the Modocs. By Jeremiah Curtin. Pp. xii + 389. (London: Sampson Low, Marston and Co., Ltd., n.d.) Price 12s. 6d. net.

"THE value of Indian myths lies in the fact that they represent the mental labour of men who lived ages before those who recorded their thoughts on papyrus, baked brick, or burnt cylinder" (p. 383). The author has supplied us with a valuable set of documents embodying the floating traditions of the Modocs, whose country lies on the borders of Oregon and California. "Man does not appear in any of these myths" (p. 383). In their non-human and non-moral elements the myths belong to the same stratum as the oldest Irish and Welsh tales, which are generally admitted to be pre-Celtic. In his too brief notes on the myths the author is evidently impressed with their obvious astronomical significance. The first he records "is evidently a sun myth." Mr. Curtin obtained the bulk of his information from "the oldest woman of the Klamath-Modoc tribe of Indians," and from one who, in the prime of his life, was chief of his people.

It is certain that if the witnesses were cross-examined on their astronomical knowledge, the astronomical significance of the myths would have appeared much clearer than it is found in the book. A golden opportunity has been missed. In one case the astronomical key was simply thrown into the author's hand. The myth of the "Star Brothers" ends as follows:

"'You and your brother will no longer be persons; you will be stars, and between summer and winter your people will fight over you.'

"The younger boy was at the edge of the sky when the old man's spirit said: 'You will be a star.' Right away he was one. As soon as the elder boy reached the edge of the sky he became a star too.

"NOTE.—These two stars appear early in the morning toward the end of winter. They are the heralds of spring" (p. 117).

It is practically certain that the author's informant could have pointed out the "Star Brothers." What we have given us is the very basis of the astronomical interpretation of myths and monuments. JOHN GRIFFITH.

A First Book of Rural Science. By J. J. Green. Pp. viii + 146. (London: Macmillan and Co., Ltd., 1913.) Price 1s. 6*d*.

THE teacher who wants to give a rural bias to his school work still has to depend at least as much on his text-book as on his garden for help in his lessons. Amidst the vast number of books on rural science that the nature-study movement has called forth, a few stand out prominently as being eminently adapted to the purpose. Amongst them we have no hesitation in placing this little book. The information is sound, and is clearly and concisely set out; while the order is both logical in method and convenient in practice.

Beginning with seeds, the author follows on with plant growth, plant nutrition, and reproduction. Next he passes to the subject of soils, and then to the relationship between the soil and the crop. Throughout the author displays a vivid knowledge of rural conditions, and he seeks to connect up the child's training with the things that come into the scholar's daily experience. This desirable end is successfully accomplished. New varieties of plants, for example, are now among the common incidents of rural life. The book gives a short but good account of how they are formed. The micro-organisms of the soil have also come in for much attention from agricultural lecturers and others, and here, again, sufficient information is given to enable the student to form an intelligent grasp of the matter. Manures are described in sufficient detail for the purpose, and manurial trials are illustrated. Altogether the book can be cordially recommended both to teachers and students.

Dent's Practical Notebooks of Regional Geography. By Dr. H. Piggott and R. J. Finch. Book ii. Asia. Pp. 64. Book iii. Africa. Pp. 48. (London: J. M. Dent and Sons, Ltd., 1913.) Price 6*d*. net each.

THESE books, and others like them, are a welcome indication that teachers in schools are beginning to understand that children learn more satisfactorily by doing than by listening. The authors are experienced teachers who recognise that with the small amount of time available for geography in ordinary classes every expedient must be tried to select only practical exercises of prime importance. In these little books the practical work is all worth doing, and the instructions given are precise and to the point.

Earthquakes and other Earth Movements. By Prof. John Milne. Sixth edition. Pp. xvi + 388. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1913.)

THE additions and alterations rendered necessary by the knowledge gained since 1903, the date of publication of the fifth edition of his book, are collected by Prof. Milne in an additional appendix of some eleven pages. The chief topics of the appendix are the teleseismic observations which, Prof. Milne says, have already thrown new light upon the homogeneity and rigidity of our world, and have led to the explanation of phenomena in other departments of science.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Ionisation of Gases in the Schumann Region.

IN July last I published a note in the *Physikalische Zeitschrift* (July 13, p. 583) on the ionisation of gases by light and the spectrum of aluminium in the Schumann region. As my views therein expressed have recently been misquoted in print on two occasions, I fear I did not make myself clear. It may be worth while, therefore, to add a word.

It was my object to explain the results of Lenard's volume ionisation experiments by exhibiting the spectrum of his source of light. To this end I published a spectrogram of the aluminium spark in air in the Schumann region. The illustration showed that, though the spectrum contained some strong lines between $\lambda 1850$ and $\lambda 1600$, there was but one group of any strength between $\lambda 1600$ and $\lambda 1250$; this group occurred near $\lambda 1300$. Lenard's data indicated that the rays which produced most of the ionisation lay on the more refrangible side of $\lambda 1600$. I stated, therefore, that the group near $\lambda 1300$ was probably responsible for most of the effect which Lenard observed, because it was the *only* strong group existing in the aluminium spectrum in the region under consideration. This is evidently very different from the opinion ascribed to me by Mr. A. Ll. Hughes (Phil. Trans., vol. ccxii., p. 226): ". . . Lyman concludes that the ionisation of air by light does not take place unless the light contains wave-lengths less than about $\lambda 1300$."

While I am on the subject, I should like to add that the question as to what wave-lengths are responsible for the volume ionisation observed in gases seems to me to be still open. We know that the effect increases with decrease in wave-length in the Schumann region, but that it "sets in about $\lambda 1350$" is not perfectly obvious. Prof. Palmer has been kind enough to test the volume ionisation due to the mercury arc, at my suggestion. He finds a small but perfectly definite effect. This confirms the recent results of Bloch, obtained with an arc in quartz (*C.R.*, vol. clv., p. 1076). I have just concluded a study of the spectrum of the arc, and I have been unable to discover any lines below $\lambda 1400$. The most refrangible line which I have observed through quartz is at $\lambda 1775$. It seems fairly certain, therefore, that some volume ionisation can be produced by light of wave-length longer than $\lambda 1700$.

THEODORE LYMAN.

Jefferson Laboratory, Cambridge, Mass., May 22.

Artificial Hiss.

HAS Lord Rayleigh tried the effect of holding a piece of sheet iron or of compressed charcoal in the small pointed flame of an ordinary foot blowpipe when the air supply is somewhat in excess of the needs of the flame? By adjusting the gas supply, the air pressure, and the position of the iron sheet, sounds can be obtained varying from *f* to *s* or *sh*. The oxy-hydrogen flame, supplied with a slight excess of oxygen, is even better. The air entering a vacuum desiccator through a narrow stopcock gives a fairly good *s* sound.

E. R. MARLE.

Hartley University College, Southampton, May 30.

In reply to the letter in Nature of May 29 (p. 319) under the heading "Artificial Hiss," the following is a suggestion which may be an answer to the question, though not a practical solution to the problem.

A loud hissing noise accompanies the passing of an electric arc across the gap in such a lamp as is used for optical lanterns, &c. Though this hissing noise does as a rule last for only a short time, yet it appears to me quite a simple matter to regulate the carbons so as to prolong the sound. The actual "hiss" sounds much more of a sibilant than an *f*, such as is produced by a current of air or steam being forced under pressure through a small opening.

Charterhouse, June 2. H. L. Kirk.

Red Water.

In Nature of April 4, 1912, Messrs. Mackenzie and Finlay wrote relative to the cause of the occurrence of colouring matter in a sample of water from a crater lake in Uganda, and subsequently in the issues of April 11 and June 6 Messrs. H. Warth and C. Crossland respectively wrote describing the occurrence of similar characteristics in the great salt lake of Sambhar, in Rajputana, also pools at Suez, and near the Rawaya salt lake.

Dr. Gavin McCallum, in a paper read at a meeting of the Geelong Field Naturalists' Club, in March, 1911, entitled "Forms of Life at the Salt-pans," directed attention to this coloration of the water and its blood-red appearance, and described it as being not due to the "colour of the liquid itself, but to the presence in enormous numbers of uniform small round cells. Dr. McCallum also mentions another form as being oval in shape with two cilia or lashes at the narrower end," the cilia and a small portion at the narrower end being colourless. At various times samples of the "red water" have been collected, and kept constantly under microscopical examination both by Dr. McCallum and myself, with the result that we can say the colouring is wholly due to a flagellate organism not unlike *Polytoma uvella*, Müll, as figured in the last edition of the "Encyclopædia Britannica," but as this is given as being a species of Chlamydomonadidæ in the article on Flagellata, and as a similar genus appears in the article on algæ by a different writer, some confusion evidently exists as to both these orders.

The oval form, as mentioned by Dr. McCallum, has two flagella, about one-third longer than the body, which appear to arise from a sort of collar or circular opening at the anterior end; there are two contractile vacuoles near the base of the flagella, and an eye-spot; except the flagella and a small portion at the anterior end, the whole organism is so deeply pigmented with red matter that it is difficult to determine its constituent parts. There are other features, but these it is at present premature to mention. The globular form appears as the brine reaches saturation point, and is a sort of resting stage conditioned by the salinity of the medium in which it lives; this form gives rise to zoospores.

Associated with the flagellate organism is an interesting crustacean, the brine shrimp, very similar to *Artemia salina*, but in all the articles dealing with this crustacean the female is said to carry the eggs underneath the tail, whereas in this shrimp they are carried in sacs on either side, like the egg sacs of the Cyclops. The male, which is much larger than the female, has the usual claspers for holding the female. Dr. McCallum mentions in his article that at 7° to 8° Baume the shrimp sickens and dies; at this stage it becomes the host of the flagellate organism, which absorbs the decaying organic matter in the interior of the shrimp's body, leaving an absolutely hyaline cast skin.

I may mention that during this period of the organism's existence it is nearly always green, the red matter only making its appearance at a later stage. As the brine reaches crystallisation the ensuing salt is of a reddish hue, due, of course, to the pigmented organism, and it is a matter of conjecture as to whether or no each spherical monad does not form the nucleus of each crystal of salt. The salt, upon exposure to the sun, bleaches, but the zoospores contained within the spherical or globular membrane retain their vitality and issue forth in countless numbers of infinitely small green, actively moving flagellate organisms, upon redissolving the salt.

Fred Whitteron.

Geelong, Victoria, March 31.

Phreatoicus in South Africa.

At the beginning of this month I found some isopods in one of the swift-running streams on the top of Table Mountain; they were quite common in and under the moss covering the stones in the bed of the stream, and were very sluggish. On examination they prove to belong to the family Phreatoicidæ. The occurrence in South Africa of a member of this peculiar family, which hitherto has been recorded only from New Zealand, Australia, and Tasmania, is of great interest as bearing on the question of the ancient land connection between the southern continents.

It is a new species, and will shortly be described in the Annals of the South African Museum.

Keppel H. Barnard.

South African Museum, Cape Town,
Cape of Good Hope, May 20.

GEOGRAPHY AND TRAVEL.[1]

(1) THIS work has originated in the desire of its author to make some public statement of indebtedness. It is, as it were, a memorial laid upon an altar. Dr. Cornish, in his researches, has dealt with phenomena that are cosmic rather than humane; yet we now perceive them set against a background, old as that of the cave-dwellers, where accomplishment is due to the fact that man does not live his life alone. Whether their vessel is rolling fifty-six degrees in the Bay of Biscay, or nearing Ceylon in incense-laden air, whether they are walking in the symbolic garden of the Shogun, or in the shattered streets of Kingston, the essential feature is that the travellers are together. The form adopted as a title merely adds emphasis to this impression.

Except for the stirring adventure of the Jamaican earthquake of 1907, these travellers saw little that others have not seen and liberally described. But what they saw they realised as trained observers. "The greatest astronomical

[1] (1) "The Travels of Ellen Cornish." Being the Memoir of a Pilgrim of Science. By Dr. Vaughan Cornish. Pp. xvi+293+plates+maps. (London: W. J. Ham-Smith, 1913.) Price 12*s*. 6*d*. net.
(2) "The Continents and their People: Asia." A Supplementary Geography. By J. F. Chamberlain and A. H. Chamberlain. Pp. ix+198+3 maps. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 3*s*.
(3) "Modern Geography for High Schools." By R. D. Salisbury, H. H. Barrows, and W. S. Tower. Pp. ix+418+vii plates. (New York: Henry Holt and Co., 1913.) Price 1.25 dollars.
(4) "Three Years in the Libyan Desert: Travels, Discoveries, and Excavations of the Menas Expedition." By J. C. Ewald Falls. Translated by Elizabeth Lee. Pp. xii+356+plates. (London: T. Fisher Unwin, n.d.) Price 15*s*. net.

interest of a voyage to the equator is to get the completed view of the Milky Way." The truth of this is memorable, when one thinks of the successive streams of stars and the unfathomable spaces, changing night after night as the vessel swings down across the line. An area of cloud sailed under for twelve days in the North Pacific (p. 90) is shown to have been as large as Australia. It "would form a considerable feature as seen from the moon. Presumably it would appear from there as a great bright patch." At Niagara numerous observations were made on the forms of waves, and one of the fine photographic illustrations is here reproduced (Fig. 1).

Dr. Cornish believes that the redistribution of load through erosion of the highland-axis north of Kingston caused a subsidence which propagated the shocks. He also has some remarks in the next chapter on earth-creep movements on the sides and floor of the Panama Canal.

It was finally Mrs. Cornish who wished, after a trying illness, to revisit Panama, "where things were being done which were worth doing." The book is a slight one, and is in no way a record of research; but none will judge it lightly who can appreciate in scientific work the stimulus of complete companionship.

(2) The "supplementary geography" of Asia is presented by Messrs. Chamberlain in language suitable for an elementary class. Numerous photographs illustrate the human aspects of the subject, and these have evidently been selected so as to leave natural features as much as possible in the background. In fact, the book is in no sense a description of the continent, but it might well be read by pupils who have already become acquainted with the great contrasts of Asiatic structure, from the Arabian desert to the volcanic isles upon the east. This is, perhaps, implied in the subtitle of the book, which conveys very little geographical teaching of the kind now looked for in progressive schools. We can conceive its being

FIG. 1.—Standing wave formed by a hidden rock, Upper Rapid, Niagara. From "The Travels of Ellen Cornish."

On p. 146 an interesting calculation is made as to how long, under modern conditions, it would take a traveller to see the world by daylight, and the "globe-trotter" is humbled when he learns that, by doing 300 miles a day, he would require 136 years to appreciate the earth.

All readers may learn something from the account of the destruction of Kingston, of the cameras carried out from the tottering house, and then put back with a fine perception when the human tragedy of the streets was realised (p. 184), of the later undulations felt upon a grass-lawn, and of the investigation of the causes of the shock when all still lay in ruin.

quite attractive as a gift-book, though twenty lines in cockney from Kipling's "Mandalay" will convey more of Asia than all the mediocre verse that is so freely quoted in its pages.

(3) The essential difference between the compact and detailed geography written by Messrs. Salisbury, Barrows, and Tower and the numerous recent American works on physical geography and physiography lies in the fact that this new book is mainly concerned with human relations to the earth's surface. But the groundwork of physical conditions is well laid. No attempt is made to describe the continents or the oceans, and this duty is probably left to the well-trained teacher and his wall-maps. Features met with on the earth are referred to their causes, and their effect on human enterprise is always kept in view. The United States are naturally selected as a groundwork for the illustration of general principles; but the book will serve admirably elsewhere in showing how teaching may be developed on these lines. "The need of salt," we are told (p. 183), "helped to hold most of the American colonists near the Atlantic coast for a long time." A quantity of salt that would now sell for some 30 cents cost *6l. 10s.* west of the Appalachian Mountains in 1778. The general benefits resulting from the continental ice-invasion are described on p. 265. Soils are adequately dealt with, and the last 150 pages are concerned with such subjects as "the uses and problems of inland waters," irrigation, life in deserts and great forests, and the causes of the distribution of population. The book shows throughout how the problems of man's existence on the earth are fundamentally due to climate and topographic features. It provides, in fact, the kind of geography which every citizen should understand, whether he is developing a local industry or extending the borders of an empire.

(4) The three years spent by Mr. Falls with his cousin, Monsignor Kaufmann, in the Libyan desert were devoted to the discovery and excavation of the early Christian sanctuary of St. Menas. Incidentally, features of the desert and of the soda-lakes are described; but the interest is naturally archæological. The photograph (p. 120) of a Beduin with his gun, seated in the waste of cut stone that represents a lost city of the empire, is one of those impressive scenes that the camera most convincingly records. But behind the camera is needed the artist with the right imaginative perception. The author mentions incidentally that photographs can be taken from a camel-saddle. As a matter of fact, this high seat is ideal for a preliminary survey, and would probably be of service in the African bush, in place of viewing the landscape from occasional ant-hills.

Miss Lee's translation is usually clear and simple; but we have doubts about the "fields" of mica on p. 57, while the account of snake-charming on pp. 303 and 304 is very puzzling. What are we to make of a "happy presentation" of snakes, or of "the Moses rod was only useful on the ground"?

G. A. J. C.

THE BIRMINGHAM MEETING OF THE BRITISH ASSOCIATION.

Arrangements for the Meeting.

THE Birmingham meeting of the British Association next September promises to be a notable one. Already more members have agreed to attend than has been the case at the corresponding period for the last few years, and the secretaries expect that the number both of local and of visiting members and associates together will reach 3000. But size, though an element in rendering the meeting notable, is not of the first importance, and it is the importance of the pronouncements made during the sessions which more than anything else stamps a meeting as of signal value. This may well be the case in Birmingham. The most important statement of the meeting is usually the presidential address, and since as president we are to have the principal of the Birmingham University, we may expect that Sir Oliver Lodge will deliver a notable pronouncement.

As a place of meeting Birmingham enjoys almost, perhaps quite, unrivalled facilities. Not merely is it centrally and accessibly situated, but its main buildings are placed unusually conveniently to one another, to the stations, and to the residential districts. A corridor or a street only intervene, as a rule, between two sections, so that the time often lost in passing from one section-room to another is here gained.

The centre of this system of sections is the reception room. This room serves almost every purpose except the one which its name implies. It is the bureau of information and headquarters of the association for the time being. It serves as the general meeting-ground, post-office, and place of supply of publications. On these accounts the town hall has been chosen, as being close to the railway and tram system.

Radiating from the town hall as a nucleus are the buildings in which the business of the association is transacted. The city council chamber will serve for the meetings of council, of the general committee, and of the committee of recommendations, the last being the financial body that allocates the grants of the association. The University building, Mason College, will contain eight out of the thirteen sections, and in addition there will be here a ladies' room, the Press bureau, the president's room, and the quarters of the permanent officers. Queen's College (no longer appertaining to the University) will lodge the economic section in its examination hall. The small lecture theatre of the Midland Institute will serve for the geographical section, whilst the closing meeting and probably the meetings of delegates will take place in the large theatre. In the Technical School, Suffolk Street, the sections devoted to engineering and chemistry will find their headquarters. Lastly, anthropology has its meeting room in the Temperance Hall, Temple Street, and is therefore the only outlying section.

Among men of science from abroad who have accepted invitations to the meeting are:—Prof.

Svante Arrhenius, of Stockholm; Prof. Reinke, the veteran botanist of Kiel; Prof. Pringsheim, of Breslau, Germany; Prof. Keibel, the embryologist of Freiburg; and M. Lallemand, the geodetic expert from Paris. The list is, however, at present incomplete.

Programme of the Meeting.

The meeting will formally open on Wednesday, September 10, with the presidential address by Sir Oliver Lodge, at 8.30 p.m., in the Central Hall, Corporation Street. The retiring president, Sir Albert Schäfer, is unable to be present owing to an engagement in America. On Thursday, September 11, the work of the thirteen sections opens with the delivery of the several presidential addresses, beginning in most cases at 10 or 11 o'clock. On Thursday afternoon there will be a reception and degree ceremony at the new University buildings, Bournbrook. The Vice-Chancellor will preside, and an opportunity will be given for an inspection of the various University departments (mining, metallurgy, engineering, chemistry, geology, and physics.)

On Thursday evening the Lord Mayor will hold a reception at the New Art Gallery, the Council House, beginning at 8.30. This will give visitors an early opportunity of realising the advance which Birmingham has made in housing and exhibiting its art collections. Also it is hoped that the new Natural History Museum will be available during the evening.

On Friday afternoon, following upon the usual spell of scientific work during the morning, there will be a garden party at Bournville, by the invitation of Messrs. Cadbury Brothers. This, and any other garden parties that may be offered to members, will naturally be limited to a specified number. Applications will be received at the reception room.

On Friday evening the first of the two evening discourses will be given by Sir Henry H. Cunynghame, K.C.B., of the Home Office, on explosions in mines and the means of preventing them, at 8.30 p.m., in the Central Hall, Corporation Street.

On Sunday special services will be arranged at most of the places of worship in Birmingham. The Lord Bishop has consented to preach in the Cathedral Church.

On Monday morning the work of the sections will be resumed, but on Monday evening the local committee will entertain the association to grand opera and to other entertainments mentioned below. On Tuesday, and probably also on the preceding Thursday, there will be a meeting of the Conference of Corresponding Societies in the Midland Institute, at 3 p.m.; and on Tuesday evening the second evening discourse will be given in the Central Hall, at 8.30, by Dr. Smith Woodward, F.R.S., of the British Museum, on missing links among extinct animals, a subject upon which he is one of the foremost authorities. On Wednesday morning the closing meeting will be held in the large theatre of the Midland Institute.

The Handbook.

The custom of the association is to induce the local committee of the place of meeting to publish two handbooks, one for the enlightenment of the visiting member, enlarging upon the history, topography, organisation, and scientific interests of the locality; the other for the enlightenment of the local member, who, in nine cases out of ten, knows little of his or her neighbourhood. The first is *the* handbook. The second is the excursion guide-book. The handbook is a work of reference, a volume of some 500 pages, laborious and expensive to produce. The guide-book is a small pocket affair that can be easily carried and consulted. Both these books are given free to every member or associate on presentation of their tickets at the reception room.

The handbook, under the editorship of Dr. Auden, this year reflects most aspects of municipal activity. The history of local enterprise, and of the chief Birmingham institutions, is dealt with by competent authorities. The existing state of these several bodies is described by others, and if the contributors had enough collective insight the future to which the city is tending, or striving for, might well be prophesied by those who had a sufficiently clear vision of what they wish to attain. In town planning this is more possible than in most other subjects, and as Mr. Neville Chamberlain has undertaken this section we may hope for an important forecast in that direction. Perhaps the sections of the work dealt with most fully will be those treating of economics and of geology; whilst, without any doubt at all, the most novel thing in the handbook will be the geological and topographical maps. These, under the guidance and help of Prof. Lapworth, mark an epoch in map-making.

Sectional Excursions.

The work of the association is not limited to that done in the meeting rooms. Most of the sections devote some time to excursions or visits. The geologists, as a rule, spend a considerable part of their time in field work, and an organised programme for this purpose has been prepared by Dr. T. T. Groom, with the supervision of Prof. Lapworth. The date of the meeting coincides with Prof. Lapworth's retirement from active university service, but it is hoped that both he and his successor, Prof. Boulton, will be able to take part in showing geologists those features of interest in the district which have been made famous by the classic investigations of the University geological staff.

The economic section, probably, will survey some part of the Midland waterways; the agriculturists have many opportunities of interesting their members in the application or the results of agricultural practice; and the engineers, geographers, and those interested in education will find much of historical or of present-day interest in the neighbourhood. But as all these excursions have naturally to be limited, it is hoped that only those members who are really interested in the subject to be studied will join the excursions.

Visits to works, either by appointment or by presentation of membership tickets, have been arranged by the excursions sub-committee. Most of these naturally appeal to engineers—for example, the Daimler works at Coventry, the Milward works at Redditch, the Great Western Locomotive works at Wolverhampton. Others, such as the Bournville works of Messrs. Cadbury, interest a larger number of visitors. Details with regard to facilities for these and other visits may be obtained in the reception room.

General (Saturday) Excursions.

The practice of the association has gradually tended to convert Saturday during the meeting into a day given up to excursions. The excursions sub-committee has planned a number of whole-day trips; whilst for those members who do not wish to give so much time, half-day excursions are available. The general programme of itineraries is as follows: Stratford-upon-Avon, Charlecote Park, and Warwick Castle; Coventry, Stoneleigh Abbey, and Kenilworth Castle; Banbury, Wroxton Abbey, Compton Wynyates, and Broughton Castle; Bromsgrove, Hewell Grange, Grafton Manor, Droitwich, Hanbury Hall, Mere Hall, Westwood, Salwarpe Court, and Hartlebury Castle; Tewkesbury, Deerhurst, Bredon, Woolas Hall, Pershore, Evesham, and Abbey Manor; Worcester; Lichfield and Wall; Sutton Coldfield and Oscott College; the Forest of Arden villages—Solihull, Knowle, Henley, Wootton Wawen, Alcester—and Coughton Court; Malvern, British Camp, and Madresfield Court.

The mayors of the cities and boroughs to be visited are offering a civic welcome to members of the association, and the owners of historic buildings and beautiful estates on the routes of excursions are offering exceptional facilities for inspection on the Saturday.

Entertainments.

The lighter side of the association week has been the subject of careful consideration by the subcommittee appointed for the purpose. For the first time grand opera is to be given. On Monday, September 15, the local committee will entertain the association in the Prince of Wales Theatre, Broad Street; in the new Repertory Theatre, Station Street; and in the Picture House, New Street.

The opera to be performed will probably be Glück's "Orpheus," under the direction of Herr Denhof, and a well-known work by a modern dramatist will be produced at the Repertory Theatre; whilst special kinemacolour and other films, dealing mainly with scientific subjects, will be displayed in the New Street Picture House.

It is a little unfortunate that the Botanical Gardens, Edghaston, cannot be used freely, but those who have an hour to spare will be well advised to go to the gardens by the Harborne motor-'bus. Botanists and zoologists particularly will find much to interest them in the exhibits.

The arrangements for working-men's lectures, and the nature of the topics to be discussed during the visit of the association, will form the subject of later articles.

F. W. G.

MICROSCOPE STANDS.

MORE than a year ago (NATURE, December 21, 1911, p. 245, and January 11, 1912, p. 351), in some articles on microscope stands, we were enabled to give the opinions of several recognised authorities on the various methods adopted to utilise the optical properties of the instrument.

It was shown that, speaking generally, there were two distinctive types, which might be conveniently styled English and Continental. Further, the English type of microscope was thus defined:—

"By the term 'English microscope' is meant the distinctive type of instrument which has been built to embody conveniences for working with modern high-class objectives and condensers, which conveniences cannot be found in combination in any other microscopes than those of British origin. Among them are the following:—(1)* The tripod foot; (2)* a long range of coarse adjustment for the use of low-power objectives; (3)* the body tube fitted with mechanical draw tube to allow for the adjustment of objectives for thickness of cover-glass; (4) the mechanical stage scientifically constructed as a part of the whole instrument; (5) the compound substage with rackwork to focus and screws to render the substage condenser axial with any objective that may be in use; (6)* fine adjustment to substage; (7)* the Wenham binocular body; (8) the various fittings for substage apparatus, eyepieces and objectives of the Royal Microscopical Society's standard gauge; (9)* all the working parts fitted with sprung bearings and controlling screws, so that compensation for wear and tear may be readily effected."

It was pointed out that in no Continental microscope are the fittings marked with an asterisk provided in the manner that is usual in an English one.

The defenders of the Continental model contended that many of the above-named means of adjustment were unnecessary, and held that the greater simplicity of the Continental model was to the advantage of the worker. Among these means of adjustment they named the centering arrangement for the substage and its fine adjustment.

It may be mentioned that the arrangement for oblique illumination and decentering of the iris diaphragm, so common in the Continental model, is of very rare occurrence on the English microscope.

One of the writers pointed out that changes were going on, and that a common ground was being approached. The centering arrangement discarded as useless for the ordinary condenser was really being introduced for an achromatic condenser and the many arrangements for dark field illumination.

Another great step in advance has recently been made. We have received from Messrs. Leitz, a German firm which produces perhaps more microscopes than any other, two models designed with a view to incorporate the most important features of the English and Continental models.

In one the tripod base is well spread, is exceptionally rigid. in the horizontal as well as the vertical position, and allows of free access to the substage. The substage is of the compound type, consisting of rack and pinion focussing adjustment, with centering screws controlling condenser sleeve, which is of the Royal Microscopical Society standard gauge. The stage is of the square fixed type, and may be provided with a detachable mechanical stage. The curved limb allows of additional working space on the stage and incidentally forms a convenient handle for lifting the microscope. The fine adjustment consists of the cam and worm screw continuous motion, originally introduced in the Leitz Continental microscopes, coarse adjustment being by diagonal rack and pinion, and draw-tube with millimeter scale.

The other form is similar, but it is fitted with a mechanical stage forming an integral part of the instrument. The stage is provided with anterior, posterior, and lateral movements of greater range than is generally found in similar models, and is controlled by two milled heads mounted upon one spindle. The stage is also provided with millimeter scales and verniers reading to 1/10 mm. (1/250 inch).

A model on the above lines, but of much larger dimensions and having a wide body-tube, is particularly valuable in photomicrography. It is stated that these new models are made in the firm's London workshop.

But Messrs. Leitz, we now find, are not the only firm which is endeavouring to make stands as complete as possible in the way of adjustment. We have received from Messrs. Angus, the London agents of the Spencer Company of the United States, one of their latest models, which is admirably designed and worked out, and in it we find the English arrangement for the centering of the substage, as well as the German device for oblique illumination.

In these new models furnished by Leitz and Spencer, then, we find the maximum of adjusting power, and on this account they may be considered to be universal instruments, and it should not be forgotten that this universal quality of adjustment need not necessarily be confined to instruments of the largest size. The mechanical stage and the oblique illumination device may be made much lighter than they generally are, and the Spencer model shows how space may be saved by mounting the two screws of the former on a vertical spindle.

One of the great outstanding differences, then, remaining at present between the English and Continental microscopes is the absence of the simple oblique illumination device in the former. Regarding the use of this we are aware there are many different opinions.

NOTES.

It is officially announced that the King has become patron of the Entomological Society of London.

At the meeting of the Chemical Society, held on Thursday, June 5, Prof. Dmitri Petrovitsch Konovaloff, of St. Petersburg, and Prof. Alfred Werner, of Zurich, were elected honorary and foreign members of the Chemical Society.

The annual conversazione of the Royal Society of Arts will be held on Tuesday next, June 17, at the Natural History Museum, South Kensington, and that of the Institution of Electrical Engineers will be held at the same place on Thursday, June 26.

The trustees of the British Museum have agreed to undertake the publication of the natural history results of Capt. Scott's Antarctic expedition. The work of publication will be carried out at the Natural History Museum, South Kensington. It is understood that on the arrival of the *Terra Nova* in this country the collections will be sent in the first place to the Natural History Museum.

The Cannizzaro prize of 10,000 lire, founded by the late Dr. Ludwig Mond, has been awarded by the Reale Accademia dei Lincei, of Rome, to Mr. Frederick Soddy, F.R.S., lecturer in physical chemistry at the University of Glasgow, for his researches in radio-activity. The presentation of the prize took place in the Capitol on June 1, in the presence of his Majesty the King of Italy.

The annual general meeting of the Research Defence Society will be held on Tuesday, June 24, at five o'clock, at the Royal College of Physicians, Pall Mall. The chair will be taken by Sir David Gill, K.C.B., F.R.S., president of the society. The report will be presented by the Hon. Sydney Holland, chairman of committee. Other speakers will be Sir William Osler, regius professor of medicine at Oxford; Bishop Frodsham, sometime Bishop of North Queensland; and Mr. Waldorf Astor, M.P.

The death is announced of Dr. Forbes Winslow in his seventieth year. Dr. Winslow was known as a specialist in lunacy, and founded the British Hospital for Mental Disorders. He was the author of numerous works on mental diseases and kindred subjects, among them being "The History of Lunacy Legislation," "Manual of Lunacy," "The Suggestive Power of Hypnotism," and "The Criminal Responsibility of the Insane." For eight years he was editor of *The Psychological Journal*.

The death is announced, in his sixty-third year, of Mr. W. McMurtrie, the predecessor of Dr. Wiley in the post of chief chemist to the U.S. Department of Agriculture. Mr. McMurtrie had served for some years as assistant chemist before his appointment to that office in 1873. In 1882 he left Washington and became professor of chemistry at the University of Illinois. While holding the latter post he was also chemist to the Illinois State Board of Agriculture. Of late years he had been a consulting chemist in New York. He was the author of monographs on the culture of the beet, the culture of sumac, grape culture in the United States, and wools and other animal fibres.

In a note in the issue of NATURE for May 22 last (vol. xci., p. 300) attention was directed to the formation of an influential committee to endeavour to establish a uniform notation in the theories of potential and elasticity. The committee of organisation has issued an appeal to astronomers, mathematicians, and physicists, asking them to cooperate in this attempt to secure uniformity, and as a beginning solicits answers to the question: "What are the notions and notations in respect of which it is desirable to establish uniformity?" Answers to this inquiry—which may be in English, French, German, or Italian—should be addressed Mr. Arthur Korn, Charlottenburg, Schlüterstrasse 25. As has been stated, discussions on the subject will be arranged to be held at the international congresses of mathematicians in 1916 and 1920, and it is hoped that the final report of the committee will be issued in 1921.

Dr. F. W. Mott, F.R.S., delivered the first of his Chadwick Public Lectures on Friday, June 6, upon the subject of "The Structure and Development of the Brain." In the course of the lecture he described the structure of the brain in relation to its function as the organ of mind, particular attention being directed to the significance of the folds and fissures, first as determining the extent of the surface grey matter, and, secondly, in the formation of a convolutional pattern. Just as faces show similar features and expression by heredity, so the convolutional pattern of the brains of relatives exhibits a similarity in its folds and fissures. The fact that a parallelism exists between arrest of development of the grey matter and feebleness of mind, and between loss of mind and the decay or destruction of the grey matter, tends to prove that the intellecual and moral character of the individual should be regarded as a natural process of organic development—a product of nature and nurture. The subject of Dr. Mott's second lecture to-morrow, June 13, at 5 p.m., at the Royal Society of Arts, is "Inborn Potentialities of the Brain of the Child."

A joint session of the Aristotelian Society, the British Psychological Society, and the Mind Association was held on June 7 and 8 at University College, London, and Crosby Hall, Chelsea. The first meeting consisted of a symposium, "Are Intensity Differences of Sensation Quantitative?" by Dr. C. S. Myers, Prof. Dawes Hicks, Dr. H. J. Watt, and Dr. Wm. Brown, under the chairmanship of Prof. Spearman. Dr. Myers showed that the "all or none" principle is obeyed by all kinds of reflexes and all kinds of sensibility. The type of reaction is therefore the correlate of quality of sensation and the difference of degree—moreness or lessness of the same reaction is the correlate of difference of intensity of sensation. The second and third meetings, presided over by the Hon. B. Russell, were devoted respectively to a discussion on memory and consciousness, opened by Dr. Robinson, and to a symposium, "Can There be Anything Obscure or Implicit in a Mental State?" by Mr. H. Barker, Prof. G. F. Stout, and Prof. R. F. A. Hoernle. Dr. Robinson said that M. Bergson, in his "Matter and Memory," neglected the fact that memory was an assertion, and that he did not do justice to the function of meaning in remembering. Intuition and intelligence must be somehow inclusively related. A vigorous discussion revealed many criticisms opposing this anti-Bergsonian thesis. In the symposium Prof. Stout maintained that within the field of consciousness, whether of mere sense experience or of thought, there are contents which are not separately discerned. The opposing point of view to this was due to a confusion resulting from the fact that the presence of implicit consciousness can only be ascertained by a process of analytic scrutiny rarely present in normal conscious life.

Mr. Ananda Coomaraswamy has issued part iv. of his useful album of Indian sculpture, "Visvakarma." The plates include two representations of the Buddhist Avalokitesvara, the personification of power, preserver of the world and men, from Ceylon; one of the local goddess, Pidári, from Madras, and a set of Nága and Nágini water or snake deities from Ceylon, Ajanta, and southern India. In some cases the reproduction of the photographs is not as clear as might be desired, but they are sufficient to answer the purpose of the publication. The collection will be of much value to students of Indian religion, archæology, and art.

The recent report of the census of the people of the Andaman Islands, taken in 1911, shows a melancholy decrease in the population. Of the Yerawa and Bojigngiji groups, estimated to number 3500 when British occupation began in 1858, only 455 survive. This decrease is attributed by Mr. R. F. Lowis to three causes—increased infant mortality in the case of parents who have come under the influence of civilisation, and to an epidemic of measles; a tendency to infertility as a result of the introduction of syphilis; an increased death-rate among adults, accounted for by the draughty buildings in which the sick are housed, and the use of clothes and blankets in hospitals, which are discarded when the patients resume their jungle life. The savage Jarawas alone, who live isolated from civilisation, seem to be holding their ground, and it is only in this group that any hope remains of the preservation of this remarkable people.

The alleged atrocities in connection with the rubber trade in the Putumayo district of Peru, now the subject of investigation, have directed attention to the Indian tribes of that region. An English explorer, Capt. T. W. Whiffen, whose evidence has been given before the Parliamentary Committee, contributes to vol. xxiv., part i., of *Folk-lore* an interesting account of these races. He was probably the first and the last white man to observe them while they were unaffected by outside influences. These tribes of the Issa-Japara River region do not, as Dr. Martius supposed, furnish an example of culture degeneration. There is no trace of any submerged superior culture; on the countrary, they have not emerged from the condition of the Stone age. While the people to the north smoke cigars and those to the south use pipes, they make a treacly decoction from the leaf which friends lick ceremonially in the tribal palaver, or to ratify a contract. When twins are born, the second, particularly if a girl, is killed; and deformed or sickly children are drowned by the mother. Among the Boro the father practises the couvade. The only social or artistic function is the dance, announced by beat of drum heard at a distance of eight or ten miles. Prisoners are slain and ceremonially eaten by their captors. After death the soul hovers round the hut for a time, and then wanders to the happy hunting-grounds of the Good Spirit. It may be hoped that Capt. Whiffen will publish a detailed account of these people, with a reproduction of the good photographs which he exhibited before the Folk-lore Society.

Those who were present at the fourth International Congress of Genetics at Paris in 1911 will always recall it as a meeting that was very much alive, and evidence of this is to be found in the report which has recently appeared. Some fifty-eight communications made to the congress are printed in this volume of nearly 600 pages. The greater part of them deal with plants, though there are a dozen papers on animals, and several of a general nature. Many of the communcations are of great interest and permanent value, and special mention may be made of Orton on the inheritance of disease resistance in plants, of Lotsy on crosses between different species of Antirrhinum, and of Walther on the inheritance of coat colour in horses. But the whole volume is full of interest and suggestion, and valuable as giving an excellent idea of the scope of genetic research, and of the great activity at present prevailing. Two languages are used throughout—French and English. A French abstract is given with the English papers, while all other papers are in French with an English abstract appended. The volume is beautifully got up and fully illustrated, a pleasant feature being the collection of portraits of workers in this branch of knowledge. It is published by Masson et Cie., and costs 25 francs.

In an address given at the anniversary meeting of the Royal Society of South Africa in March last, the president of the society, Dr. L. Peringuey, dealt with the antiquity of man in South Africa. So far no human remains have been found in South Africa which belong to the Palæolithic period. On the other hand, stone implements of the various European Palæolithic periods of culture abound in South Africa—Chellean, Acheulean, and Mousterian—but there is no evidence that these types followed each other in point of time; all seem to have been in use at the same period. Dr. Peringuey is convinced that there was a direct relationship between the later Palæolithic cultures of Europe and South Africa—the Aurignacian and Solutrean. The problem of determining the degrees of antiquity of the various Palæolithic cultures of South Africa is rendered difficult by the fact that the climate and the fauna of South Africa have altered very little, if at all, during the Pleistocene period, whereas in Europe there have been recurring periods of change. Lately the fossil remains of two extinct antelopes—"gnu- and pallah-like creatures"—have been discovered in the Free State, with large flakes and other implements of a Palæolithic type. Remains of very similar antelopes occur in the Pliocene formations of India and Attica. Molar teeth of a mastodon have also been found in gravels of the Vaal River along with Palæolithic implements. It will be thus apparent that man's presence in South Africa is of great antiquity, although as yet the necessary data have not been gathered for estimating the degree of that antiquity. So far only Europe and certain parts of America have been searched for man's earliest traces; it seems very probable that Dr. Peringuey and his colleagues may soon be in a position to elucidate, by their discoveries in South Africa, some of the problems which are at present puzzling their European colleagues.

Mr. R. S. Pearson, of the Indian Forest Service, has published (Indian Forest Records, vol. iv., part v.) a detailed and valuable report on the utilisation of bamboo for the manufacture of paper pulp. Four species of bamboos (*Bambusa arundinacea, B. polymorpha, Cephalostachyum pergracile, Melocanna bambusoides*) were examined with regard to their suitability for paper-making; the area over which the examination took place was restricted to Lower Burma and the west coast of the Indian peninsula, as both these localities are geographically well suited for import and export purposes, and contain vast areas covered with bamboos. Figures as to yield, &c., were carefully collected; in order to obtain practical proof of the quality and cost of preparing pulp from bamboos about eighty tons of raw material of the four species were converted into pulp, and eventually into paper at Calcutta; and the report is printed on paper made from *B. polymorpha* (the most useful species), both nodes and internodes being used. The report contains very valuable data for estimating the probability of the success of establishing a paper-pulp industry in Burma and India.

The interesting weather maps for May 9–15, published in the first issue of the Meteorological Office charts of the North Atlantic and Mediterranean for June, show a continuation of the type of conditions which had prevailed during the preceding two weeks, affording a noteworthy illustration of an almost stationary cyclonic system over the north-eastern quarter of the Atlantic for nearly three weeks. The high pressure in the north of Europe and western Siberia spread along the arctic circle to Iceland, formed a barrier against the eastward progression of Atlantic disturbances, and held the depression above referred to in practically the same position until nearly the middle of May. The latest reports showed that "a huge area of high barometrical pressure covered nearly the whole of the North Atlantic." Some icebergs were passed in 42° 30′ N. and 49° W. about April 4. Since April 10 (up to the time of going to press, on May 15) ice had not been sighted south of latitude 44° N.

"Forecasting the weather" is the title of an interesting bulletin (No. 42) by Mr. G. S. Bliss (section director), recently issued by the U.S. Weather Bureau. It shows the great advantage enjoyed by the bureau in being able to watch the developments and movements of storm-areas over the entire country between the Atlantic and the Pacific, and from Canada to Mexico and the West Indies, by the receipt of telegrams twice daily containing observations made at the same physical instant of time. The author shows how perfectly the machinery works, and how rapidly the operations are performed, from observation to map-making. In less than two hours the various forecasters are prepared to issue particulars for a day or two in advance for any State or city with nearly as high a degree of accuracy as they can for their own locality. This useful bulletin is accompanied by weather maps and an epitome of the various processes at work in the atmosphere, to assist students in applying to the maps the principles learned in a cursory study of the elements. It is claimed that by mapping the whole northern hemisphere the Weather Bureau is enabled to forecast general conditions for a week or ten days in advance with a creditable degree of accuracy.

It is well known that the distance of the epicentre of a great earthquake is determined by the duration of the first series of preliminary tremors. The relation is not a simple one for all distances, but Mr. G. Negri states (*Anales de la Soc. Cien. Argentina*, vol. lxxv., 1913) that the duration I_1 of the preliminary tremors in minutes and the distance S of the epicentre measured along a great circle in thousands of kilometres are connected by the following relations: if S be equal to or less than 1, $I_1 = 2{\cdot}05.S$, if S lie between 1 and 9, $I_1 = \sqrt{(16834.S)} - 2{\cdot}32$, and if S be greater than 9, $I_1 = (S + 5{\cdot}929)/1{\cdot}463$. Thus the curve which represents these relations consists of three portions which are respectively straight, parabolic, and straight. Mr. Negri suggests that earthquakes which originate at distances represented by the above limits might be termed near, distant, and antipodal.

In the May number of *The American Journal of Science*, Prof. L. P. Wheeler, of Yale, examines the more recent measurements of the refraction and dispersion of metals in the light of the electron theory of dispersion. The experimental data cover silver, copper, gold, nickel, and cobalt, but the accuracy attained is still insufficient to make the comparison satisfactory. It appears, however, from the results available that the number of free electrons in each of these metals must increase with the frequency of the incident radiation slowly and fairly uniformly in the infra red, and more rapidly in the regions for which the metals are transparent. The dispersion due to the free electrons is more important than that due to the bound electrons, especially in the region of short wave-lengths, and the form of the dispersion curve given by theory agrees with that found experimentally in its main features, although the inaccuracies of the experimental results do not permit of any satisfactory comparison of details.

Science Progress for April contains an important article by Dr. J. V. Eyre on the projected revival of the flax industry in England. Dr. Eyre has, on behalf of the Development Commissioners, visited, during the past two years, the principal flax-growing countries of Europe, and made a special study of the methods adopted in cultivating the plant and separating the fibre. The information gathered has been recently presented to the Commissioners in the form of a report, which is summarised in the article now referred to. The inquiry leaves no room for doubt that the climate of this country is well suited to flax, and experiments are in progress as to the possibility of cultivating and separating the fibre at a profit. Taking into account the fact that flax is now worth nearly twice as much as it was ten years ago, and other considerations which are specified in detail, there is strong reason to believe that the judicious revival of the industry by improved methods would be of benefit to British agriculture. During the past year flax was grown in Bedfordshire experimentally as a fibre crop, and useful information gained as to the more difficult operations of harvesting and retting, special tanks being constructed for the latter purpose. It is proposed in the present year to make trials on a larger scale, and for this purpose a society has been formed under conditions of non-profit trading, so as to be eligible for a grant from the Development Commission.

The third of a series of articles on the Panama Canal appears in *Engineering* for June 6, and deals with the lock-gates. The locks are 110 ft. wide, and have a nominal length of 1000 ft.; intermediate gates are provided, together with valves, allowing lengths of chamber of 278·5, 370, 550, 908·5 and 1000 ft. respectively to be employed, an arrangement which will result in a considerable saving of time and water with vessels of short length. The gate leaves are built of flat girder work sheathed with plating, and the whole of the support is given by a pintle at the base and a yoke above; there is no roller path provided. The leaves have a length of nearly 65 ft. and are 7 ft. wide; the largest are 82 ft. high. The largest leaf has a weight of 1,483,700 lb. The material used in the gates is open-hearth steel, having an ultimate tensile strength of 60,000 lb. per sq. in. Under ordinary conditions, the working stresses do not exceed 13,000 lb. per sq. in., and do not exceed 15,000 lb. per sq. in. under extreme conditions.

The city of Edinburgh recently appointed a commission "to visit various cities in England with a view of inspecting self-propelled cars and obtaining further information on the subject." The deputation has issued a report which is commented upon in *Engineering* for June 6, and gives some valuable data as to various installations for running tramcars by petrol, in place of by cable or by electricity. At Morecambe the autocar service was opened eighteen months ago: the line is 1·2 miles long, and passes through a sparsely populated district. The first year's working shows a surplus of receipts over all expenditure. The car seats thirty-seven passengers; its weight unloaded is 8 tons. It is propelled by a 40 h.p. four-cylinder petrol engine, the mileage per gallon of petrol being seven to eight. The average daily run for each car is about seventy miles. The total cost of car is from 985*l*. to 1150*l*. The Leyland Motor Company, which built the cars, gave a five years' guarantee that the costs of working, exclusive of wages, upkeep of car body, and administration expenses, should not exceed $3\frac{1}{4}d$. per car-mile so long as the price of petrol did not exceed 9*d*. per gallon. Birmingham, Coventry, and London were also visited, and as the result of the inquiries, the deputation recommends the introduction experimentally of petrol-driven cars in Edinburgh.

AMONG the latest additions to the "Cambridge Manuals of Science and Literature" are five volumes dealing with scientific subjects. Prof. John Cox, under the title "Beyond the Atom," tells the story of discoveries in radio-activity, and his brief summary of the work of Rutherford, Curie, and many others will prove of interest to students and general readers alike. Dr. Gadow's book on "The Wanderings of Animals" gives the main facts of geographical distribution in a readable form. Prof. Fortescue writes on wireless telegraphy for readers with a general scientific knowledge who desire to know something, not only of the accomplishments of wireless, but also of the means by which they are attained. Mr. O. H. Latter's book on "Bees and Wasps" deals with British species of Hymenoptera in a thoroughly practical manner, and Mr. Clement Reid's "Submerged Forests" gives a simply worded account of a very interesting series of geological researches. The "manuals" are one shilling net each, and at the rate the library grows the student will be able soon to secure at this small cost an authoritative account of every branch of modern scientific research.

OWING to the development of their optical business, Messrs. Newton and Co., 72 Wigmore Street, London, W., are unable to find space for their philosophical and physical apparatus department, and are consequently disposing of their stock at low prices. The catalogue of apparatus for sale is comprehensive, and includes particulars of shop-soiled and second-hand instruments used in the study of physics and chemistry, lanterns and lantern apparatus, and microscopes and accessories.

OUR ASTRONOMICAL COLUMN.

THE VARIATION OF SOLAR RADIATION.—With the permission of the secretary of the Smithsonian Institution, a definite and important statement under the names of Messrs. C. G. Abbot, F. E. Fowle, and L. B. Aldrich is published in the *Astronomische Nachrichten*, No. 4656, with the title "The Variation of the Sun." The observations from which the conclusions are drawn were begun in the year 1902, when preliminary experiments were made at Washington to determine the solar constant of radiation. About 700 determinations of it have now been secured, and they depend on observations made at altitudes ranging from sea-level to 4420 metres. The results, some of which are mentioned in this communication, will be published in detail in the Annals of the Astrophysical Observatory of the Smithsonian Institution (vol. iii.) now in the press, and will probably appear next month. The authors nevertheless publish in this statement some of the more important conclusions, which are as follows:—

(1) The mean value of the solar constant of radiation for the epoch 1905–12 is 1·929 cal. per sq. cm. per min. (2) An increase of 0·07 cal. per sq. cm. per min. in the "solar-constant" accompanies an increase of 100 sun-spot numbers (Wolfer). (3) An irregular variation frequently ranging from more than 0·07 cal. per sq. cm. per min. within an interval of ten days is established by numerous nearly simultaneous measurements at Mount Wilson, California, and Bassour, Algeria. (4) Indications of two wholly independent kinds incline the authors to think that these variations of solar radiation are caused within the sun, and not by interposing meteoric or other matter.

The extreme importance of the conclusions here stated cannot be overrated, and students of solar physics in its broadest sense will await with eagerness the publication of the detailed investigation.

PROMINENCES ASSOCIATED WITH SUN-SPOTS.—The discovery of radial motion in sun-spots by Mr. Evershed revealed the fact that there are two opposite movements in the penumbra of every spot, the gases at the level of the reversing layer flowing outwards away from the umbra, while those at the higher levels of hydrogen and calcium flow inwards. It was thought that a study of the higher solar region, namely that of the prominences, might shed some light on these remarkable motions, and with this object Mrs. Evershed undertook a study of the fine prominence photographs taken at the Kodaikanal Observatory. The results of this investigation are described in the current number of the Monthly Notices of the R.A.S. (vol. lxxiii., No. 6), and they are accompanied by a series of fine reproductions of numerous types of prominences explained in the paper.

Mrs. Evershed states that the investigation suggests more problems than it solves, yet some preliminary conclusions are nevertheless drawn. The most general result seems to indicate that the movements observed in the prominences situated directly above sun-spot groups are of quite a different kind from those in the penumbræ of spots, being intermittent and variable in direction and amount instead of uniform and constant. Reference is also made to the presence of forces other than those of an eruptive and gravitational nature, which is responsible for such a peculiarity as was observed in some rising prominences which moved with an accelerating velocity into space by a force opposed to gravity.

STUDIES IN STELLAR STATISTICS.—The general question of the distribution and motion of stars in space is perhaps the most important problem of the day, and the attention of astronomers has been turned more and more towards it since the initial investigation of Kapteyn in 1904, who determined for the first time the elements of the two star-streams. Space will only allow here of a list of a few of the more recent papers connected with this subject. Mr. F. W. Dyson has contributed to the two last numbers of the Monthly Notices of the R.A.S. (vol lxxiii., Nos. 5 and 6) two important researches on the distribution in space of the stars in Carrington's circumpolar catalogue, discussing in the first the proper motions in a direction perpendicular to the solar motion, and in the second the proper motions in the direction of the solar motion. In the same publication (No. 6) Mr. H. C. Plummer continues his series of papers on stellar motions, the title of this contribution being "A Preliminary Discussion of the Galactic Motions of the Bright Stars of Type I., with Some Additional Material." Mr. C. V. L. Charlier, in the *Meddelanden fran Lunds Astronomiska Observatorium*, series ii., No. 9, publishes the second of his studies in stellar statistics, entitled "The Motion of the Stars," giving an account of an extensive research into the proper motions of Boss's catalogue based on correlation methods.

RECENT OBSERVATIONS OF NOVÆ.—The results of a valuable piece of work are recorded by Prof. E. E. Barnard in *Astronomische Nachrichten*, No. 4655. They relate to the present appearance of many of the novæ which have been discovered from time to time. The following is a very brief digest of some of the notes he gives, but reference should be made to the original paper for further details of each star:—

Nova	Discovered	Max. recorded mag.	Present mag.	Remarks
T Coronæ	1866	2	9	Colourless
Cygni	1876	3–4	15·0	Hazy
Andromedæ	1885	6	Invisible	—
Aurigæ	1891	4·5	14	Ill-defined
Sagittarii	1898	4·7	15	Hazy and ill-defined
Persei	1901	<1·0	12·05	Colourless
Geminorum (1)	1903	8·16	16·3	—
Aquilæ	1905	5	<17	—
Lacertæ	1910	5·0	12·5	Nebula bluish-white
Geminorum (2)	1912	4	8± (fluctuating)	—

With regard to the last nova, Prof. Barnard writes: "On February 8, 1913, with good seeing and at the proper focus the Hα image of Nova Geminorum No. 2 was clearly seen. It was small and sharp and intensely crimson, and was surrounded by a greenish-blue halo some 3″–4″ in diameter. The normal focus, however, was not different from that of an ordinary star."

THE NATIONAL PHYSICAL LABORATORY DURING 1912.

THE annual report of the National Physical Laboratory, Teddington, was presented to the meeting of the general board on April 25, and marks another milestone of steady progress. The birth of the laboratory but some ten years ago is fresh in the minds of most of us, but many may not realise the extent of its development; few institutions can indeed parallel it in rapidity of growth.

As a nation we were late in starting a national laboratory, but we have been unusually quick in making use of the facilities and advantages which it affords. To it from all parts of the Empire come requests for advice and assistance—requests increasingly exacting and ever-widening in scope; the National Physical Laboratory is fast taking its place as the Imperial laboratory. Its staff, formerly fewer than half a dozen, now numbers 150 of all grades; its history recounts an uninterrupted succession of new buildings. Progress such as this bears witness to the labour and devotion which the director, Dr. Glazebrook, has showered on the laboratory, to the loyal cooperation of his staff, and to the wise administration of the Royal Society.

The National Physical Laboratory is steadily gaining in the nation's appreciation; in common fairness the nation should put itself in the position of being able to say that it has provided for the laboratory in such fashion that financial cares need not distract its administrators from their proper sphere. The laboratory should be able to attract and keep on its staff brilliant young men who are keen to work at research for the profit of the nation and the advancement of learning. The men are not wanting; it is for the country to see that their remuneration is commensurate, and that they are adequately housed and equipped for their work.

The laboratory is being increasingly consulted by the different Government Departments. During the year various matters have been carried out for the Admiralty, the War Office, the Foreign Office, the Home Office, the Board of Trade, the Local Government Board, the India Office, &c. Last year the expenditure amounted to more than 32,000*l.*; the Treasury grant was only 7000*l.* The remaining 25,000*l.* had to be raised by payments for work done and by donations.

A new building designed to accommodate the administration offices and the optics division is approaching completion; this will satisfy a most imperative need. Generous donors have supplemented the special Treasury grant of 15,000*l.* for the purpose; these include the 1851 Commissioners (5000*l.*) and a number of the City Companies. But further funds for equipping these and other departments are urgently needed. The new buildings are to be opened by the Right Hon. A. J. Balfour on the day of the annual visitation, Thursday, June 26.

Turning now to the work of the year, its comprehensive nature is at once evident. The National Physical Laboratory is a physical laboratory in the widest sense, and accordingly we find in its yearly record papers on almost every branch of physics and technology. Some forty original communications were published during the year; it is possible now to touch on only a few of these.

Taking first the work on the fundamental electric units, the Lorenz apparatus for the determination of the ohm in absolute measure was completed during the early part of the year, and a large number of experiments have already been carried out by Mr. F. E. Smith. Some idea of the precision attained may be gathered from the fact that the estimated probable error of any single measurement is of the order of two parts in 100,000. The final result of the measurements is not yet available, but it may perhaps be said that the value will probably be somewhat less than has been generally supposed. Comparisons with the resistance-standards of the Bureau of Standards, the Reichsansalt, and the Laboratoire Central d'Electricité have been made during the year, with the result that the English and German values were found to agree within one part in a million; the American value was ten parts in a million greater.

Mr. Campbell has evaluated the ohm in absolute units by two alternating-current methods, remarkable for their ingenuity. The testing of wavemeters is becoming an important feature of the work in the electrical department.

The British Radium Standard, consisting of 21 milligrammes of extremely pure radium-chloride, is now deposited at the laboratory. Dr. G. T. Beilby provided the funds for the purchase of the standard, which has been compared with the international standard at Sèvres, and will shortly be available for standardising radium preparations.

An important paper dealing with the discharge of electricity from carbon at high temperatures was presented to the Royal Society by Dr. Harker and Dr. Kaye. By reason of the conditions and magnitude of the experiments, ionisation currents amounting to several amperes were obtained.

The thermometry division is investigating the thermal conductivities of the various heat insulators used for cold-storage purposes, and for steam-pipe lagging—a piece of work which presents special difficulties and has long been needed. The equipment for testing the thermometers hitherto verified at Kew Observatory has been set up; some idea of the magnitude of this work will be gathered from the fact that more than 33,000 thermometers were tested last year. A research on the viscosity of oils has been completed by Mr. Higgins.

The photometric division has conducted an inquiry into the visibility of ships' lights, and is at present engaged in an investigation of "glare," particularly that produced by motor-car headlights. Intercomparisons of candle-power units have been made with the Bureau of Standards and the Reichsanstalt through the medium of tungsten filament lamps (Mr. Paterson). The agreement of the results is extremely good, and incidentally affords evidence that the photometry of lights of different colours is not of necessity liable to the errors which are commonly attributed to it. Work has been published by the electrotechnics division on the electric strength of ebonite, the compressibility of micanite, the dielectric losses in insulators (Mr. Rayner), and the heating of flexible cords and cables (Mr. Melsom).

Some important researches have been carried out

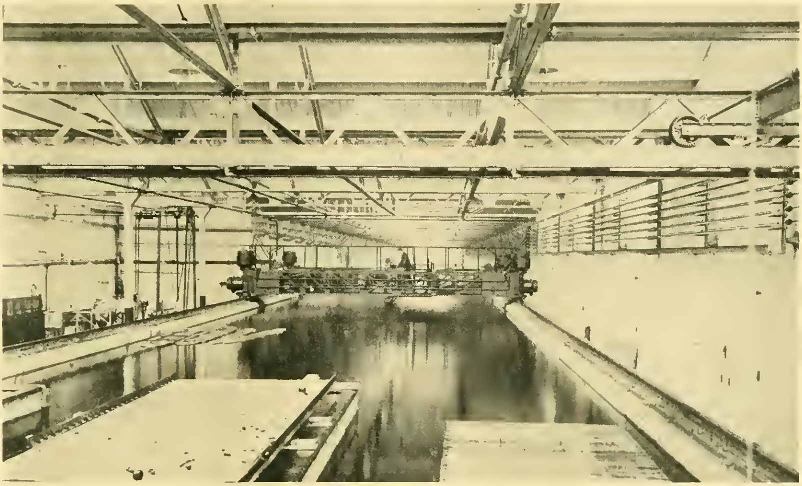

FIG. 1.—The tank and carriage, with model ready for towing.

FIG. 2.—Model being towed—showing waves created.

by Mr. Baker and his colleagues in the Naval Tank. The most noteworthy is that with a series of ship models, each having the same principal dimensions, but with a different distribution of the displacement in a longitudinal direction. The experiments revealed the limits of speed to which various forms can be driven without excessive wave-making, and have also increased the general knowledge of eddy-making at the sterns of ships. An extensive series of experiments has also been carried out on hydro-aëroplane floats. Fig. 1 gives a general view of the tank with a model in place under the carriage by means of which the model is towed. Fig. 2 shows the wave profiles for a model of mercantile form with fairly bluff ends. It is satisfactory to note how very small the loss of water from the tank still continues—a tribute to its design and construction.

In the metallurgical department, Dr. Rosenhain and Mr. Archbutt have published the tenth report of the alloys research committee of the Institution of Mechanical Engineers. The report, which deals with the alloys of zinc and aluminium, contains features of great interest in view of the increasing importance of light alloys in aëronautical and instrument work. Dr. Rosenhain and Mr. Ewen have communicated an important paper on intercrystalline cohesion in metals, while Mr. Humfrey has been working on the effects of strain in iron at high temperatures.

The metrology division has been largely occupied with the arrangements for the reception of the Kew Observatory test work. The behaviour of the silica standard metre has been closely followed, and the value of its expansion-coefficient determined (Mr. Donaldson).

Dr. Stanton and his staff have carried out extremely valuable work in a number of directions, more particularly on wind-pressures (at the Tower Bridge), on the frictional high-speed flow of water and air in pipes, and on the pressure and flow round aëroplane surfaces. The experiments conducted in the 4-ft. wind channel have afforded valuable information to the Royal Aircraft Factory at Farnborough in designing biplanes and dirigible balloons. The Treasury has accordingly authorised the erection of a new 7-ft. channel at the laboratory; this is now approaching completion.

The new experimental road constructed for the Road Board is complete, and abrasion and endurance tests have been begun.

The optical division has been concerned with the testing of photographic shutters, the absorbability of glass for ultra-violet light, and the testing of telescope objectives and trial lenses. The staff took an active part in the organisation and proceedings of the Optical Convention which was held during the year at South Kensington.

This short summary may suffice to give a notion of some of the many fields of activity in which the National Physical Laboratory is working for progress. There are important problems waiting to be taken up; it is in many cases purely a question of "ways and means" which prevents a start being made.

THE ROYAL OBSERVATORY, GREENWICH.

At the annual visitation of the Royal Observatory on June 7, the Astronomer Royal, Dr. F. W. Dyson, F.R.S., presented his annual report. The following extracts indicate the chief items of interest:—

The observatory has ceased to generate its own electric current for lighting and other purposes, and now obtains current from outside. Alternating instead of direct current is now used, and a small supply of direct current is obtained by means of a rotary converter.

In the new magnetic observatory, shortly to be erected, provision is made for the continuation of the long series of Greenwich observations of the variations of the magnetic elements. This series is unique as regards the length of time during which observations have been made on the same site. The care which has been taken to guard the observatory from all artificial electromagnetic disturbances which could affect the accuracy of the observations has preserved the suitability of the site for such work.

Observations of double stars have been made with the 28-in. refractor from a working catalogue containing all known double stars showing appreciable relative motion, and a number of pairs from the catalogues of Hussey and Aitken under 2″ separation. κ Pegasi was observed on five nights, δ Equulei on three nights, 70 Ophiuchi on thirteen nights, and ϵ Hydræ on one night.

The 26-in. refractor, the 30-in. reflector, and the 6-in. Cooke triplet have been in constant use during the year. The new cell for the crown lens was received and mounted in July. The adjustment of the crown and flint lenses for tilt and eccentricity relative to one another was made in August.

During the year 164 plates were taken for determination of stellar parallax, 124 of these being new plates and forty being re-exposures of plates taken six months previously. The programme for each star consists of six photographs. Three photographs taken in the evenings are re-exposed in the mornings about six months later, and are then developed. Three plates are exposed in the mornings, and, after re-exposure six months later, are also developed. For several stars the cycle has been completed and the plates have been measured for three stars. The results obtained are $+0{\cdot}082'' \pm 0{\cdot}017''$, $+0{\cdot}043'' \pm 0{\cdot}009''$, and $-0{\cdot}014'' \pm 0{\cdot}012''$. The star which gave a negative parallax is one with a small proper motion. It is considered that these probable errors are too large, and that one of $\pm 0{\cdot}005''$ should be attainable. The increased constancy in the adjustment of the object glass secured by the new cell, and the use of the rotating sector by which the star observed is reduced to the magnitude 10·5m. to 11·0m. of the comparison stars, are expected to make a considerable improvement.

The 6-in. Cooke triplet which belonged to the late Mr. Franklin Adams has been employed in the determination of the photographic magnitudes of the stars brighter than 9·0m. in the Greenwich astrographic zone. During the year fifty-three photographs of fields compared with the standard polar area have been taken. Fifty-six plates have been measured, completing the eighty-eight necessary for the whole zone. The catalogue of the resulting magnitudes is nearly completed, and will contain 8000 stars.

Fifty-nine photographs of Neptune and satellite, taken in 1909–10, have been measured, and the results published.

At the date of the last report, 152 out of the 206 Franklin-Adams photographs had been counted in the manner then explained. During the year fifty of the remaining plates have been dealt with. The four plates still uncounted have not yet been received from Johannesburg.

The requisite photometric data for the reduction of these counts to statistics based on actual photographic magnitudes are now being obtained at a steady rate. The plan of taking long exposures on a field and a standard polar area has been abandoned, because of the rarity of nights on which the sky is uniform and constant for more than one hour. Instead of this, exposures of 5m. duration are being taken on the central fields of the Franklin-Adams plates and on the standard polar area. The actual procedure consists in giving an exposure of 5m. on a field taken at the same altitude as the pole, two exposures on the pole, and then a second exposure on the field. These will serve to determine standard magnitudes down to the 13th or 14th magnitude on the Harvard photographic scale. With these short exposures it will be possible to make several determinations for each field required. For the fainter stars photographs will be taken with a wide grating and the magnitudes derived by comparison with the diffracted images of the brighter stars. These determinations have the advantage of being independent of the changing transparency of the sky. The star-images are compared with a scale formed by taking a number of different exposures on the same plate—the scale being calibrated by the Harvard standards.

With the astrographic equatorial 176 photographs have been taken on fifty-nine nights. Of these, 154 were for the determination of the photographic magnitudes of the stars in the Greenwich section of the Astrographic Catalogue by the method described in last year's report, and 107 of them were considered satisfactory for the purpose. There are now twenty-nine plates on the working list to be taken to complete the series.

Attention is directed to the determination of the position of the sun's axis which has been carried out by Mr. Maunder. The attempt has been made to utilise as fully as possible the long series of measures of the positions of sun-spots made at Greenwich. Although Carrington's determination proves to be only a few minutes in error, it is desirable that the position of the sun's axis should be obtained with all possible precision, and that the limits of accuracy should be known. A redetermination should be made at each sun-spot cycle.

An apparatus was set up on July 5 for the reception of the wireless time-signals from the Eiffel Tower and Norddeich. The signals have been constantly observed since that date, the morning signals being observed each day (except Sundays). The night signals from the Eiffel Tower have been observed on 128 and the rhythmic signals on eighty-two occasions. The night signals from Norddeich have been observed on 124 occasions. The morning signals from the Eiffel Tower were observed by both Mr. Lewis and Mr. Bowyer on 167 days; there is a mean difference $L-WB=-0{\cdot}066$s. in their times of observation with an accidental discordance of $\pm 0{\cdot}06$s. between the observers. Similarly in the receipt of the Norddeich signals the two observers showed a mean personal difference $L-WB=-0{\cdot}043$s., and a similar accidental discordance. Thus the ordinary signals are observed by either observer with a mean error of less than $\pm 0{\cdot}05$s. The rhythmic signals are apparently received with an error of less than $\pm 0{\cdot}01$s., and the mean discordances between these and the ordinary signals are less than $\pm 0{\cdot}05$s.

As regards the actual difference between the time sent out by the Eiffel Tower and that of the Greenwich 10h. and 1h. signals, from 184 observations Mr. Lewis makes the Eiffel Tower signal 0·256s. late on Greenwich, and Mr. Bowyer from 234 observations makes it 0·313s. late. It is supposed that the difference is mainly due to the difference of personal errors of the standard observers at Paris and Greenwich. The mean discordance after allowing for this constant difference is $\pm 0{\cdot}11$s.

The Norddeich signals are, according to 160 observations of Mr. Lewis, 0·297s. late on the Greenwich time signals, and 0·340s. late according to 229 observations of Mr. Bowyer. Allowing for this there is an accidental discordance of $\pm 0{\cdot}23$s.

The daily comparison of the Eiffel Tower signal affords a useful regular check on the time as determined at Greenwich. At the request of the director of the Paris Observatory, this comparison has, since the installation of the receiving apparatus, been forwarded daily to him as a check on the rate of the clock at Paris. These comparisons are specially serviceable in cloudy weather. In October the Astronomer Royal attended the "Conférence internationale de l'heure" as one of the British delegates, where the further development of the wireless time-service was discussed. The distribution of time in this way is of great value to navigators, and is likely to be of importance in the determination of longitude on land.

ORNITHOLOGICAL NOTES.

THE May number of the New York Zoological Society's Bulletin is devoted to the needs and results of wild-life protection in America, more especially as regards birds. A feature of this issue is a coloured plate representing five species of brilliantly coloured birds—the quezal, the great bird of paradise, the scarlet ibis, the cock-of-the-rock, and the white egret—which are in special danger of extermination in various parts of the world. Altogether, it is estimated that something like one hundred species are in danger owing to the feather trade or on account of their value as food. It is no answer to say that the present comparative abundance of some of these species renders protective measures unnecessary, for it is pointed out that the same argument was used in 1857 in the case of the passenger-pigeon and Wilson's snipe, the former of which is now extinct, save for one survivor in the zoological gardens at Cincinnati. The purchase of Marsh Island as a bird sanctuary by Mrs. Sage is recorded as an important step in the right direction.

In connection with the above may be noticed an article by Mr. B. H. Grove in the May number of *The American Naturalist* on the influence of agricultural development in Wyoming on the bird-fauna, in which it is pointed out that several species are on the increase, while others—notably the quail—have made their first appearance, as new-comers, into this State during the last few years.

The January number of *The Emu* contains the report of a committee of the Royal Australasian Ornithologists' Union appointed to consider the nomenclature of Australian birds and to publish a revised list of names. Although the list which accompanies the report is not based on absolute priority, the committee acknowledges its indebtedness, in its compilation, to the one recently published by Mr. G. M. Mathews, in which that principle is adopted throughout. Trinomialism is rejected.

In an article by Capt. H. Lynes on the drumming of snipe in the May issue of *British Birds*, it is pointed out that the performance is normally connected with the sexual function, but that it may occasionally take place at other seasons, although always within the limits of the breeding area. R. L.

THE AMERICAN PHILOSOPHICAL SOCIETY.

THE annual general meeting of the American Philosophical Society was held in Philadelphia on April 17–19 inclusive. A large number of papers was presented, their general character being of a high order of merit, and it is possible here to refer only to a few of them. The president, Dr. W. W. Keen, was in the chair at most of the meetings.

In a contribution on the flora of Bermuda, Mr.

Stewardson Brown, conservator of the botanical section of the Philadelphia Academy of Natural Sciences, said that more than 1450 separate collections of plants have been made from all parts of the archipelago, with the exception of a few of the smaller islands which are only rocks with but little vegetation. The native species of flowering plants and ferns, exclusive of the endemic forms, number 155, all of which are identical with those existing on the American mainland or the West Indian islands. The fourteen endemic species, four of which have been added through these studies, are all more or less nearly related to those of the south-eastern United States, West Indies, or tropical continental America, and are probably derived from such ancestors by modification during long periods of isolation. It would appear that the greater portion of the native flora has come to Bermuda from the south-west through the agency of ocean currents, hurricane winds, and migratory birds, of which a considerable number of species visit the islands regularly each year.

Prof. George E. Coghill, professor of zoology, Denison University, Granville, Ohio, read a paper on the correlation of structural development and function in the growth of the vertebrate nervous system. Recent studies in comparative neurology have resolved the central nervous system of vertebrates into four longitudinal divisions which are severally functional units. Among lower vertebrates the relative development of these divisions, the somatic sensory, the visceral sensory, the somatic motor, and the visceral motor, has been in a significant manner correlated with the behaviour of the species. Such correlations by the comparative method formed the point of departure for this study on the correlation of the behaviour of embryos with the developing structures in the growth of the nervous system. Some of the more general results of this method of study are (1) the demonstration of the nature of the primary reflex arc of the vertebrate nervous system; (2) the discovery of the adaptive nature of the early reflexes when considered from the phylogenetic point of view; (3) proof that the final common path of the most primitive reflexes is elaborated into the nervous mechanism of locomotion; (4) the explanation of the typical behaviour of a vertebrate upon the basis of demonstrable reflex arcs; (5) a distinctive contribution towards a biological neurology.

Prof. Victor C. Vaughan, professor of hygiene and physiological chemistry in the University of Michigan, dealt with the nature and significance of fever. It has been shown experimentally that fever is due to the digestion of proteins in the blood and in the tissues. Bacteria are living proteins. They get into the body and grow, converting the proteins of man's body into bacterial proteins. After a period of incubation the cells of the body pour out a ferment which digests and destroys the bacteria. In this process fever originates. In itself fever is beneficial: it is a manifestation of the attempt on the part of nature to destroy the invading organism. However, nature may overdo the matter, and fever *per se* become dangerous when it goes much above 105°. Any kind of fever, acute fatal, intermittent, remittent, or continued, may be induced in animals by repeated injections of properly graduated doses of foreign protein.

Prof. Mazÿck P. Ravenel, professor of bacteriology in the University of Wisconsin, described the control of typhoid fever by vaccination. In the United States vaccination against typhoid fever was recommended in 1909. The results were so favourable that it was made compulsory for all officers and enlisted men under forty-five years of age in 1911. The most striking results were obtained during the mobilisation of troops in Texas in 1911. There were 12,801 troops in Texas, all vaccinated. There was only one case of typhoid fever, occurring in a private of the hospital corps, who had not completed his immunisation. The case was mild and resulted in recovery. In 1898 10,759 troops were stationed in Jacksonville, Florida, under very much the same conditions as regards climate, &c. Vaccination was not practised at that time. There were 2693 cases known or believed to be typhoid fever, with 248 deaths. The French troops in Morocco, under most unhygienic surroundings, have entirely escaped typhoid fever where vaccination was practised. In Wisconsin the State Laboratory of Hygiene sends out the vaccine free of charge to all physicians in the State. In more than 3000 vaccinations only two cases of typhoid fever have come to notice; both these cases mild and atypical.

A paper on Guatemala and the highest native American civilisation was read by Prof. Ellsworth Huntington, of Yale University. Among the native civilisations of the western hemisphere that of the Mayas was decidedly the highest. Not only did they develop the arts of architecture and sculpture to a surprisingly high point, but they were the only American race to evolve the art of genuine hieroglyphic writing. To-day the magnificent ruins of the later, decadent Maya period, dating about 1000 A.D., are relatively accessible, as they lie in the dry and well-populated strip which borders the peninsula of Yucatan on the north. The oldest ruins, however, those representing the period of highest development a few centuries after the time of Christ, are located in one of the most inaccessible regions of America. In the last 1500 years, more or less, there must have taken place a change of great magnitude. Three possibilities present themselves. First, the Mayas may have possessed a degree of energy, initiative, and of resistance to fevers much in excess of that of any other known people. Secondly, in their day tropical fevers of the more destructive types may have been unknown in Central America. And thirdly, the climate may have changed. Alluvial terraces and their relation to such ruins as Copan furnish strong independent evidence of climatic pulsations during the past 2000 years.

Prof. W. M. Davis, of Harvard University, discussed Dana's contribution to Darwin's theory of coral reefs, and an account of his paper has already appeared in these columns (February 6, 1913, p. 632.)

Dr. Charles D. Walcott, secretary of the Smithsonian Institution, gave illustrations of a remarkable and ancient fossil fauna discovered by him in the mountains of British Columbia, 2000 ft. above Field, on the Canadian Pacific Railway. The fossils are most beautifully preserved, and include such delicate forms as Medusæ, holothurians, finely preserved marine shells of various kinds, and a variety of crustaceans. Some of the latter are so perfectly preserved that the branchia, legs, and alimentary canal are shown, and even in several forms the liver is so perfect that the ramifications of the tubes through it are reproduced by photography. Altogether more than eighty genera of invertebrate fossils have been found from a bed not more than 5 ft. in thickness. They are all of marine origin, and lived at a period when there were no vertebrates in existence.

The Alleghenian divide and its influence upon freshwater faunas was described by Dr. Arnold E. Ortmann, curator of invertebrate zoology in the Carnegie Museum of Pittsburg. Although it is known that the Allegheny Mountains form a boundary between the aquatic forms inhabiting their western and eastern slopes, particulars about the relations of the two faunas were missing. Dr. Ortmann furnished facts for a number of aquatic forms of life, chiefly the fresh-water mussels, the Pleuroceridæ, and the crayfishes, covering the region from the New York-Pennsylvania State line to the northern boundary of Tennessee. The main results are that the groups mentioned have not been transported overland to any extent, and consequently are apt to furnish evidence as to the former drainage conditions. The Allegheny Mountains have acted most of the time as an effective barrier to the dispersal of fresh-water life, at least since the end of the Cretaceous. The Atlantic side received its fauna from the interior basin—not across the mountains, but around the northern and southern ends. A few instances are known where single species crossed the divide, and these cases are found in two sharply restricted regions.

Progressive evolution among hybrids of Œnothera was discussed by Prof. Bradley M. Davis, of the University of Pennsylvania. Certain cultures of hybrids between *Oenothera biennis* and *O. grandiflora* have presented in the second generation a high degree of progressive advance in flower size and in the size of the leaves and the extent of their crinkling. An hypothesis for such progressive evolution is offered by the Mendelian principle of recombination of factors for large size on the assumption of multiple factors for the dimensions of organs, but this hypothesis also demands the presence in the same culture of groups of plants containing the factors for small size. When in an F_2 generation there is a considerable group of plants with flowers larger than those of the larger parent there should also be expected corresponding groups with flowers as small as, or smaller than, those of the smaller parent. In F_2 generations of about 1000 and 1500 plants respectively there were no groups of plants with flowers as small as, or smaller than, those of *O. biennis*, the small-flowered parent. The cultures as a whole presented a marked advance in flower size. A similar situation was presented by the character of the foliage in certain F_2 generations The leaves throughout the mass of these cultures were much larger than those of the parents and generally much more crinkled. It is difficult to explain the results on strict Mendelian principles of segregation. Admitting the complexity of the situation when such an extreme cross is made as that between *O. biennis* and *O. grandiflora*, there still appears to Dr. Davis sufficient reason in the data at hand to present the problems as material for reflection on the Mendelian theory of the stability of factors and the principles of their distribution unchanged in the organisation of gametes.

Attention was given to the subdivision of the United States into climatic areas more or less susceptible of quantitative definition by Prof. Burton E. Livingston, professor of plant physiology in Johns Hopkins University, in a paper on climatic areas of the United States as related to plant growth. From a thorough study of the climatic data which are at hand, it appears that any two systems of isoclimatic lines, one system representing the geographical distribution of temperature conditions and the other representing that of moisture conditions, have a strong tendency to cross each other, thus dividing the country into climatic areas, each one capable of quantitative description.

Dr. William Duane, late of the Curie Radium Laboratory, University of Paris, referred to some unsolved problems in radio-activity (illustrated). He discussed such questions as: How can atoms which are physically and chemically similar to each other yet be so different that some of them will disappear immediately and others not for a long time? The explanation of this probably lies in the internal structure of the atom and not in external causes, for external conditions have no known effect upon the phenomenon. The second unsolved problem to which attention was directed was connected with the rays given off by the substances during their transformations. The third problem had to do with the γ rays. He asked: Is the γ ray a wave form spreading out as sound waves do from their source, or is it of corpuscular nature resembling the sparks projected from an exploding rocket? The fact that the β ray, which the γ ray is capable of producing, does not depend upon the distance from the source of the γ ray to the point at which the β ray is produced seems to indicate that the latter hypothesis is correct.

Dr. Edward C. Pickering, director of the Harvard College Observatory, introduced the subject of the determination of visual stellar magnitudes by photography. Ordinary photographic plates are most sensitive to blue light, while the yellow rays are those that effect the eye most strongly. Accordingly, blue stars appear brighter and red stars fainter in a photograph than to the eye. Isochromatic plates are, however, manufactured which are very sensitive to yellow light. If a yellow screen is interposed, the blue light is cut off and red stars appear even brighter, relatively, than they do to the eye. By using a thin yellow screen which cuts off only a portion of the blue rays it is possible to obtain plates having the same colour index as the eye. To fulfil this condition several blue and several red stars have been selected near the north pole. Photographs are then taken with different screens until one is found which gives images of the same relative brightness as the naked eye. With the 16-in. Metcalf telescope at Harvard, stars as faint as the twelfth magnitude may be photographed in this way with an exposure of ten minutes. With an exposure of two hours, stars can be photographed about as faint as they can be seen with a telescope of the same size. On a perfectly clear night a photograph is taken of the north pole with exactly ten minutes' exposure, then similar exposures on four different regions, then a second time on the north pole, on five other regions, and a third time on the north pole. The twelve plates are developed together and various precautions taken to secure uniform results. The magnitudes of numerous stars near the north pole have been measured with great care, and the magnitudes of the stars on the other plates can thus be determined on the same scale.

The spectroscopic detection of the rotation period of Uranus was the subject of a paper by Dr. Percival Lowell and Dr. V. M. Slipher, of the Lowell Observatory, Flagstaff, Arizona. By means of the spectroscope, it is possible to measure the speed of approach or recession of a luminous body; for the lines of the spectrum are shifted toward the violet or red in proportion as the body moves toward or from the observer. Hence, if the image of a rotating planet be so thrown upon the slit of the spectroscope that one end of the slit is illuminated by light from the approaching side of the planet and the other end by light from the receding side, the lines will be tilted through an angle which measures the speed of rotation. In this way, from spectrograms obtained at the Lowell Observatory in 1911, the authors determined the rotation of the planet Uranus about its axis to take place in ten hours and fifty minutes, in a direction opposite to that of the rotation of the planets nearer the sun. Thus, for the first time, an authentic determination of the rotation of this planet has been made by a direct method.

Dr. V. M. Slipher also described the spectrum of the nebula in the Pleiades. Two photographs of the spectrum of the faint nebula near Merope, a bright star in the Pleiades, were obtained in December, 1912, with a slit spectrograph attached to the Lowell 24-in. refractor. The two plates were exposed five and twenty-one hours respectively. They agree in showing a continuous spectrum crossed by the dark lines of hydrogen and helium, the spectrum of the nebula being a true copy of that of the brighter stars of the Pleiades. The light of the nebula is thus shown to be of stellar origin. As it seems improbable that a mass of stars, all of the same spectral type as the Pleiades, should so group themselves behind the Pleiades as to give the appearance of a nebula, the author believes it more probable that the nebula consists of diffused material surrounding the stars and shining by reflected starlight. This is the first successful observation ever published upon the spectrum of this faint nebula.

A symposium on wireless telegraphy and telephony was an important part of the meeting. Among the papers read was one on radiated and received energy, by Dr. Lewis W. Austin, head of the U.S. Naval Radio-Telegraph Laboratory. Mathematical theory indicates that the energy radiated from a radio-telegraphic antenna will produce an electromotive force on a receiving antenna proportional to the current in the sending antenna, to the height of the sending antenna, to the height of the receiving antenna, inversely proportional to the wave-length, and inversely proportional to the distance between the two antennas. Since the loudness of signal is proportional to the square of the current in the receiving antenna, the signal falls off as the square of the distance between the two. This law has been verified by the experiments made by the United States Navy Department between the new high-power station at Arlington and several other stations situated in and near Washington. Observations at distances above 100 miles show that in addition to the diminution in intensity of signal with the distance, there is in an absorption either in the atmosphere or ground, such that at a distance of 1000 miles over salt water, with a wave-length of 1000 meters, the received current is only approximately 1/25; that is, the received signals are reduced to 1/600 of what they would have been had there been no absorption. The absorption decreases as the wave-length is increased, so that for communication over great distances, long waves 4000 to 7000 metres in length are used, while for short distances of a few hundred miles short waves are better, since they are radiated more energetically. These facts apply to daylight communication only, which is in general regular, night ranges, though greater than day, being freakish and uncertain. The absorption over land is much greater than over water, especially for the shorter wave-lengths. In recent tests between the Arlington station and the scout cruiser *Salem*, on its voyage to Gibraltar and return, messages were received from Arlington in the day-time on the *Salem* up to a distance of 2100 nautical miles, and at night as far as Gibraltar. A comparison was also made of the action of two types of sending sets, one being the regular spark-sending set and the other a set in which the waves are produced from an electric arc. It has been claimed that the continuous waves emitted by the arc are less absorbed than the broken-up trains of waves produced by the spark. Up to 1000 miles no difference in the absorption was observed, but at 2000 miles the observations indicated that the received arc energy was relatively four times greater than that of the spark.

During the meeting Sir A. J. Evans, Sir Joseph Larmor, and Dr. Schuster were elected foreign members of the society.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—Prof. W. S. Boulton, professor of geology at University College, Cardiff, has been appointed to succeed Prof. C. Lapworth, F.R.S., who is retiring at the close of the present session. Before his appointment to University College, Cardiff, Prof. Boulton had been assistant lecturer in geology at Mason College, under Prof. Lapworth.

Dr. O. J. Kauffmann has been appointed successor to Prof. A. Carter, as joint professor of medicine, and the chair of surgery, vacated by Prof. G. Barling, on his election as Vice-Chancellor, has been filled by the election of Mr. W. P. Haslam.

Dr. T. Stacey Wilson has been invited to deliver the Ingleby Lectures for 1914.

Dr. P. T. Hughes is to represent the University at the International Congress of Neurology and Psychiatry at Ghent.

Leeds.—At the request of the Development Commissioners, the University has undertaken the preliminary arrangements for an investigation in flax growing and in the methods of retting which would be suitable for a central rettery. Selby has been chosen as the chief place of experiment, and 120 acres of land have been sown with various selected types of seed. Negotiations are in progress for the establishment of a central rettery where the whole crop may be treated. The Treasury has sanctioned a grant from the Development Fund to cover the cost of the preliminary steps. The question of the subsequent control and direction of the experimental station is still being considered by the Development Commissioners.

Oxford.—The annual report of the delegates of the Oxford Museum, which was presented to Convocation on June 10, is a lengthy document occupying thirty-two pages of the *University Gazette*. It includes separate reports of the museum departments, prepared by the regius professor of medicine, the professors of pathology, physiology, human anatomy, comparative anatomy, zoology, experimental philosophy, physics, engineering science, chemistry, geology, rural economy, and mineralogy, by the curator of the Pitt-Rivers Museum, and the reader in pharmacology. The introductory matter records the resignation of Prof. Odling, and the election of Prof. Perkin to the vacant chair of chemistry, together with the appointment of Mr. J. A. Gunn to the newly established readership in pharmacology. The reports of the several professors give evidence of much activity in both teaching and research; in most cases they include lists of important additions to the collections of specimens and the stock of apparatus. The longest and most elaborate contribution is that of the Hope professor of zoology (Prof. Poulton), whose account of the work of his department takes up more than half of the whole publication. The events of which he makes special mention are the taking over by his department of the lower portion of the south room of the old Radcliffe Library, and the meeting of the International Congress of Entomologists at Oxford last August. Attention is directed to many valuable additions to the collection, and particularly to the African insects presented by Messrs. K. St. A. Rogers, W. A. Lamborn, J. A. de Gaye, and Dr. G. D. Carpenter. An interesting list of accessions to the Pitt-Rivers collection is given by the curator (Mr. H. Balfour), who makes special mention of stone implements collected in Ashanti by Mr. R. S. Rattray, a former diploma student in the department. Space will not allow mention of the other reports, all of which contain matter of interest.

Dr. T. K. Monro has been appointed professor of practice of medicine in the University of Glasgow, in succession to the late Prof. S. Gemmell.

Mr. P. F. Kendall, junior assistant curator of the zoological museum of the University of Sheffield, has been appointed lecturer in zoology and geology in the South-Eastern Agricultural College at Wye.

The widow of the late Dr. Hervieux, who died six years ago, has given 4000*l.* to found two bursaries for poor students. We learn from the *Revue Scientifique* that Mme. Hervieux has also bequeathed to the Paris Academy of Medicine a bust of her late husband.

Under the auspices of the Edinburgh Mathematical Society, a mathematical colloquium will be held in Edinburgh during the week beginning Monday, August 4, and lasting five days. The following courses of lectures have been arranged:—"The Theory of Relativity and the New Physical Ideas of Space and Time," Prof. A. W. Conway; "Non-Euclidean Geometry and the Foundations of Geometry," Dr. D. M. Y. Sommerville; "Practical Harmonic Analysis and Periodogram Analysis: an Illustration of Mathematical Laboratory Practice," Prof. E. T. Whittaker, F.R.S. Further particulars may be obtained from the honorary secretary of the Edinburgh Mathematical Society, 19 Craighouse Terrace, Edinburgh.

The prospect of early educational legislation has led lately to much discussion and to many speeches by prominent persons on various aspects of the problem of providing an adequate and properly organised system of education. Opening the new buildings on June 6 of the Newcomen's Foundation Domestic Trade School for Girls in London, the President of the Board of Education, Mr. Pease, said that when the history of the past fifty years comes to be written it will show that there has been too great an effort to make individuals read books. The result has been that people too often take their opinions from books, instead of forming them for themselves as the result of their own experience, their own thought, and their own work.—On June 6 and 7 the annual meeting of the Association of Education Committees was held, and resolutions were passed (*a*) declaring that it is imperative that a revision of the incidence of the cost of education as between the national and the local contributions shall precede any further legislation or administrative action which will increase the cost of education; (*b*) expressing the opinion that a new form of State contribution should be substituted for the very unsatisfactory system of grants to local education authorities, and that the Exchequer grants should increase automatically as new and increased responsibilities were put upon local education authorities; (*c*) expressing the opinion that the time has arrived when the strongest possible protest should be offered to local authorities undertaking any further financial obligations until the Government has redeemed its promise of further financial aid. Mr. Pease, who attended the meeting, said it is realised that more money ought to be given by the State in support of education, and that education committees should cooperate one with another with the view of coordinating the whole system of education in the country and making it more perfect.

Commemoration Day at Livingstone College, Leyton, was held on June 7, and formed the centenary celebration of David Livingstone's birth. After a preliminary statement by the principal (Dr. C. T. Harford), the chairman (Bishop Montgomery) addressed the meeting. He emphasised the importance of medical training for missionaries, especially for those who had to go to tropical countries. Sir A. Pearce Gould said that the life of Livingstone was an outstanding contradiction to and repudiation of materialism. He spoke of the value of the college training for all missionary students, and urged the advantage of the course for missionaries on furlough, who would thus be brought into touch with recent medical researches. He referred to Livingstone's skill as a physician, and to his anticipations of modern research. Livingstone clearly saw the close connection between mosquitoes and malaria, and that there was an absence of malaria in the highlands where there were no mosquitoes, but in the lowlands where they swarmed malaria was prevalent. Livingstone recognised that the bite poisoned the blood, and noted that "the germ which enters when the proboscis is inserted to draw blood, the poison germ, is capable of reproducing itself." Livingstone also saw clearly the high importance of quinine in cases of fever. The Rev. W. D. Armstrong, who had been fifteen years on the Congo, spoke of the extreme value of his medical training in the maintenance of his own health whilst he was sampling Congo diseases, and in the valuable work he was able to do for his wife and fellow-missionaries at critical times. He spoke of the frequent call for help from traders, who were often entirely dependent on the missionary for medical help. This relationship had been an efficient means of establishing good relations between traders and missionaries in the troublous times of the rubber controversy. At the conclusion of the meeting the visitors had opportunities of examining the college laboratory for research in tropical diseases and the Livingstone relics which were on exhibition.

SOCIETIES AND ACADEMIES.

London.

Royal Society, June 5.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. R. **Broom**: The origin of mammals (Croonian Lecture). An endeavour is made to trace the evolution of mammals from Cotylosaurian ancestors through the carnivorous Therapsida.—Dr. E. A. Newell **Arber**: The fossil floras of the Wyre Forest, with special reference to the geology of the coalfield and its relationships to the neighbouring Coal Measure areas.

Zoological Society, May 20.—Prof. E. A. Minchin, F.R.S., vice-president, in the chair.—Dr. R. **Broom**: The South African pseudosuchian reptile Euparkeria and allied genera. Besides giving an account of the very completely known South African form, the author also discussed the structure of the Elgin allied forms, Ornithosuchus and others. The group of pseudosuchians he regarded as an extremely important primitive reptilian order, as there is good reason to believe that not only does it contain the ancestor of the dinosaurs, but also the ancestors of the pterodactyles and birds. Euparkeria and Ornithosuchus are, in structure, almost dinosaurs, and it is held that when the bipedal habit was more fully acquired the few characters not quite dinosaurian would become dinosaurian. Birds are held to have originated from a pseudosuchian which, by a bipedal habit, had acquired a dinosaur-like hind limb, and had then become arboreal in habit and acquired the peculiar power of flight.—E. G. **Boulenger**: Experiments on the metamorphosis of the Mexican axolotl (*Amblystoma tigrinum*). A detailed description was given of the changes that take place in the course of transformation. The author also exhibited a number of specimens in the perfect or amblystome condition. The conclusions arrived at, as a result of his experiments, were that, in accordance with Mlle. de Chauvin's experiments, and contrary to those of Dr. Powers, the axolotl will, with a few exceptions, transform if placed under special conditions which force it to breathe air more frequently than usual; that starvation, irregular feeding, and temperature have no influence on the metamorphosis; that the elimination of oxygen from the water has likewise no bearing on the point, as the animal will not, in the circumstances, rise to the surface and make use of its lungs at more frequent intervals than animals placed under normal conditions.—G. E. **Bullen**: Some cases of blindness in marine fishes. Work hitherto performed, *e.g.* that of Hofer, de Drouin de Bouville, and others, upon the pathology of fishes has been directed largely upon species of fresh-water habitat. The present author has found, in certain specific cases of blindness in marine fishes, pathological conditions similar to those described, and others with slight modifications, in several fresh-water species. The examples dealt with in detail are traumatic corneal opacitis in a conger-eel, corneal opacitis, &c., in a greater weaver, and corneal opacitis and cataract in a pollack. Dr. R. W. **Shufeldt**: The patella in the Phalacrocoracidæ. From a study of the patella in a number of species of this family, the author had found that in adult individuals that bone was composed of the true patella solidly fused with the proximal portion of the cnemial process of the tibiotarsus, which became dissociated from the latter early in the life of the bird. Late in life this fusion obliterated the tendon of the ambiens muscle, which heretofore had been described as passing through the patella and persisting through life.

Royal Meteorological Society, May 21.—Mr. C. J. P Cave, president, in the chair.—E. **Gold**: Determination of the radiation of the air from meteorological observations. The theory of the cooling of the air during the night hours was developed and applied to observations made near the earth's surface and 130 ft. above it, in order to obtain an estimate of the radiating power of the atmosphere. The results obtained show that even on calm, clear nights, when the air at the higher level is warmer than that near the surface, the cooling of the air is affected by convection, and the observations available do not suffice for the determination of the correction to the value of the radiating power necessary on this account.—S. C. **Russell**: Results of monthly and hourly cloud-form frequencies at Epsom, 1903–10. The author had made hourly records of the varieties of cloud observed each day throughout the eight years, and these he has grouped under fifteen forms of cloud. The total number of individual records approximates to 100,000. The cumulus cloud yielded the greatest number of daily values (1622), the stratus coming next (1155). The upper clouds, which include the cirrus, cirro-stratus, and cirro-macula, showed a marked prevalence during the summer with minima during the winter. Morning and evening maxima, with a mid-day decline, are common to all these varieties. The intermediate clouds, which include cirro-cumulus, alto-stratus, alto-cumulus, and cumulo-stratus, are also more prevalent in the summer than in the winter. The lower forms, which include strato-cumulus, nimbus, fracto-nimbus, fracto-cumulus, stratus, and fog, attain their maxima in the winter months, their minimum frequency being in the summer. The clouds of diurnal ascending currents, cumulus and cumulo-nimbus, are independent of any seasonal variation in hourly frequency, the maxima at noon and 3 p.m. respectively, taking place at these hours in every month of the year.

Geological Society, May 28.—Dr. Aubrey Strahan, president, in the chair.—P. G. H. **Boswell**: The age of the Suffolk valleys, with notes on the buried channels of drift. The main watershed of Suffolk follows generally the Chalk Escarpment. Suffolk forms a plateau, dissected by a valley-system which is palmate in form. The strata cut through by the valleys, and the mantle of glacial deposits which more or less covers the whole county, are described briefly. Reasons are given for thinking that the Contorted Drift does not extend far south of the Waveney. The valleys, although they may have been etched earlier, are on direct evidence post-Pliocene in age; but, by analogy with the Waveney and the Norfolk rivers, they may be younger than the Contorted Drift. The Upper Boulder Clay covers much of the plateau, and wraps down into the valleys. The Glacial Sands, &c., below it also appear at times to lie on the valley-slopes. Intense glacial disturbances are found to be situated always on "bluffs" or "spurs" of the plateau, which were in existence before the advent of the valley-glaciers to the action of which the disturbances have been attributed. In each of the main valleys occur one or more buried channels of drift; borings made recently allow these to be described in detail, and the deposits filling them to be discussed. These buried channels were probably eroded by sub-glacial water-streams. The evidence indicates that the pre-Glacial or early Glacial contours of Suffolk were in the main much as they are now.—D. E. **Innes**: The internal structure of Upper Silurian rugose corals from the Grindrod collection, Oxford Museum.

Physical Society, May 30.—Prof. A. Schuster, F.R.S., president, in the chair.—Prof. A. W. **Bickerton**: The origin of new stars. The author gave an account of a theory which he has held for many years. He points out that the energy developed by mutual fall of colliding suns is so great that shearing must ensue. Hence the problem of oblique impact of all suns is taken in two divisions—first, the actually colliding parts that are torn away and coalesce, and, secondly, the parts that escape the collision but are profoundly influenced by it. The impact of meteoric swarms, nebulæ, and sidereal systems may similarly be taken in two parts. The coalesced part is called the third body. The properties of this new body are best studied in the third star resulting from grazing suns. The third star is thermodynamically unstable, and selectively sorts its atoms into ensphering shells. It rotates, and has at its formation a special distribution of its elements. It will produce a new star. Its deduced properties correspond with the three criteria of thermodynamic intensity, complex light curve, and the physical peculiarities shown in each series of the spectrograms of novæ.—Dr. W. H. **Eccles**: Electro-thermal phenomena at the contact of two conductors with a theory of a class of radio-telegraph detectors. The paper deduces mathematically the laws connecting the current and the applied E.M.F. in a circuit containing a light contact of two conductors. When an electric current passes across a light contact of two different substances, heat is liberated or absorbed in accordance with the law of Peltier, heat is generated in accordance with the law of Joule, and, in the regions of the conductors where there is a temperature gradient, heat is liberated or absorbed in accordance with the laws of the Thomson effect. These thermal actions are very noticeable in contacts made of badly conducting natural oxides or sulphides on account of the high resistivity and the large thermoelectric effects in these substances. The low thermal conductivities of these substances exalt the electrical consequences by conserving the heat. The bulk of the wireless telegraphy of the world is carried on by such contacts as these, and the present paper, therefore, constitutes a theory of the action of these detectors.—**J. Walker**: The extraordinary ray resulting from the internal reflection of an extraordinary ray at the surface of a uniaxal crystal. By the principle of least time it is shown that the diameter of the extraordinary wave-surface described round the point of incidence, that is, conjugate to the reflecting surface, is coplanar with the incident and reflected extraordinary rays, and is the median of the triangle formed by these rays and a parallel to the reflecting surface. The direction-cosines of the reflected ray are then obtained in terms of those of the incident ray and the said diameter of the wave-surface.—**S. Butterworth**: The evaluation of certain combinations of the ber, bei, and allied functions.

NEW SOUTH WALES.

Linnean Society, March 26.—Mr. W. W. Froggatt, retiring president, in the chair.—*Annual General Meeting*.—Presidential address: "A Century of Australian Civilisation, from a Zoologist's Point of View." The address was devoted to a consideration of the great changes that have been wrought by the advent of the white man with his domestic animals, in the displacement of the aboriginal population and the original fauna, in the course of a hundred years' civilisation.—*Ordinary Monthly Meeting*.—Mr. W. S. Dun, president, in the chair.—A. H. S. **Lucas**: Notes on Australian marine algæ. No. 1.—H. J. **Carter**: Revision of the Australian species of the subfamilies Cyphaleinæ and Cnodaloninæ (family Tenebrionidæ).

April 30.—Mr. W. S. Dun, president, in the chair.—A. B. **Walkom**: Stratigraphical geology of the Permo-Carboniferous system in the Maitland-Branxton district, with some notes on the Permo-Carboniferous palæogeography in New South Wales. The vertical succession of the formations represented in the area under consideration—Lower Marine Series, Greta Coal Measures, and Upper Marine Series—has been worked out in some detail. Vertical sections of the Lower Marine Series were obtain in three localities, showing a thickness of nearly 4800 ft. In his important monograph on the geology of the Hunter River Coal Measures of New South Wales (1907), Prof. David mapped the outcrop of this series and gave numerous detailed sections of the coal seams developed at many points along the outcrop; but, at this time, very little was known about the development between Branxton and Pokolbin. Additional data now available show that in four localities, as elsewhere, the main Greta seam is split, and that the upper split has been struck in ach case; the lower split seems to be entire at Rothbury, but splits again further north.—A. B. **Walkom**: The geology of the Permo-Carboniferous system in the Glendonbrook district, near Singleton. The Glendonbrook district lies from five to fifteen miles E. by N. from Singleton. Permo-Carboniferous rocks are developed there in a small isolated basin. They consist chiefly of sandstones, conglomerates, and shales belonging to the Lower Marine Series, Greta Coal Measures, and Upper Marine Series. The whole basin is only some three miles in diameter, and is surrounded by rocks of Carboniferous age. Further to the west, nearer Singleton, owing to heavy faulting, rocks belonging to the Upper Coal Measures and Upper Marine Series also appear. All these rocks are described more or less in detail, and their relations to one another discussed. A coal seam about 10 ft. thick occurs in the Greta Coal Measures in the basin mentioned above.—A. B. **Walkom**: Notes on some recently discovered occurrences of the pseudomorph, glendonite. Glendonite, a pseudomorph after glauberite, has been recorded from seven horizons in New South Wales and Tasmania, all, however, in the Upper Marine Series. In this paper, the occurrence of the mineral in rocks of the Lower Marine Series is recorded for the first time, with details of a comparison of crystals from both series.

BOOKS RECEIVED.

"J." A Memoir of John Willis Clark. By A. E. Shipley. Pp. xi+362. (London: Smith, Elder and Co.) 10*s*. 6*d*. net.

The Essence of Buddhism. By P. L. Narasu. Second edition. Pp. xx+359. (Madras: S. Varadachari and Co.)

The Posture of School Children. By J. H. Bancroft. Pp. xii+327. (London: Macmillan and Co., Ltd.) 6*s*. 6*d*. net.

Jesus Christus und sein Stern. By A. Stentzel. Pp. vi+240+16 plates. (Hamburg: Astronomischen Korrespondenz.) 6 marks.

Schriften der Naturforschenden Gesellschaft in Danzig. Neue Folge. Dreizehnten Bandes. Zweites Heft. Pp. 1+167. (Danzig.)

34 Bericht des Westpreussischen Botanisch-Zoologischen Vereins. Pp. 20+268. (Danzig.)

Le Système du Monde des Chaldéens à Newton. By J. Sageret. Pp. 280. (Paris: F. Alcan.) 3.50 francs.

Determinative Mineralogy, with Tables. By Prof. J. V. Lewis. Pp. iv+151. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 6*s*. 6*d*. net.

The Textile Fibres. By Dr. J. M. Matthews. Third edition. Pp. xi+630. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 17*s*. net.

A Monograph on Johne's Disease (Enteritis Chronica Pseudotuberculosa Bovis). By F. W. Twort and G. L. Y. Ingram. Pp. ix+179+9 plates. (London: Baillière, Tindall and Cox.) 6*s*. net.

Cambridge County Geographies. Lincolnshire. By Dr. E. M. Sympson. Pp. viii+193+2 maps. (London: Cambridge University Press.) 1*s*. 6*d*.

The Control of Water, as Applied to Irrigation, Power, and Town Water Supply Purposes. By P. A. M. Parker. Pp. vii+1055. (London: G. Routledge and Sons, Ltd.) 21*s*. net.

Pflanzenmikrochemie. By Dr. O. Tunmann. Pp. xx+631. (Berlin: Gebrüder Borntraeger.) 18.50 marks.

Grundzüge der geologischen Formations- und Gebirgskunde. By Prof. A. Tornquist. Pp. iv+296. (Berlin: Gebrüder Borntraeger.) 6.80 marks.

The Venom of Heloderma. By L. Loeb, with the collaboration of C. L. Alsberg, E. Cooke, E. P. Corson-White, and others. Pp. vi+244. (Washington, D.C.: Carnegie Institution.)

The Food of Some British Wild Birds. By W. E. Collinge. Pp. vii+109. (London: Dulau and Co., Ltd.)

Human Behavior. By Profs. S. S. Colvin and W. C. Bagley. Pp. xvi+336. (London: Macmillan and Co., Ltd.) 4*s*. 6*d*. net.

The Science of the Sciences. By H. Jamyn Brooks. Pp. 312+ix. (London: D. Nutt.) 3*s*. 6*d*. net.

Maps and Survey. By A. R. Hinks. Pp. xvi+206+xxiv plates. (London: Cambridge University Press.) 6*s*. net.

Hampstead Heath: its Geology and Natural History. Prepared under the auspices of the Hampstead Scientific Society. Pp. 328+xi plates+3 maps. (London: T. Fisher Unwin.) 10*s*. 6*d*. net.

Memoirs of the Geological Survey. England and Wales. The Concealed Coalfield of Yorkshire and Nottinghamshire. By Dr. W. Gibson. Pp. vi+122+iii plates. (London: H.M.S.O.; E. Stanford, Ltd.) 1s. 6d.

Annual Report of the Council of the City and Guilds of London Institute. Pp. xlix+125. (London: Leonard Street, E.C.)

Weights and Measures Act, 1904. Board of Trade Notices Annotated. By H. Cunliffe and G. A. Owen. Vol. i. Pp. viii+199+vii plates. (Smethwick: H. Cunliffe.) 5s. net.

A Bibliography of the Tunicata, 1469–1910. By J. Hopkinson. Pp. xii+288. (London: The Ray Society; Dulau and Co., Ltd.) 15s. net.

Tanners' Year Book, 1913. Pp. 178. (London: The Technica Publishing Company.)

Hausa Folk-Lore, Customs, Proverbs, &c. Collected and Transliterated with English Translation and Notes. By R. S. Rattray. 2 vols. Vol i., pp. xxiv+327. Vol ii., pp. 315+iii plates. (Oxford: Clarendon Press.) 2 vols., 30s. net.

Handbuch der Pharmakognosie. By A. Tschirch. Lief. 31–34. (Leipzig: C. H. Tauchnitz.)

Metallographie. By Dr. W. Guertler. Erster Band, Die Konstitution. Heft 7–12. (Berlin: Gebrüder Borntraeger.)

Yorkshire Type Ammonites. Edited by S. S. Buckman. Part ix. (London: W. Wesley and Son.)

Outlines of Stationery Testing. By H. A. Bromley. Pp. 74. (London: C. Griffin and Co., Ltd.) 2s. 6d. net.

The Earth: its Genesis and Evolution. By A. T. Swaine. Pp. xviii+277+xii plates. (London: C. Griffin and Co., Ltd.) 7s. 6d. net.

Electricity in Mining. By Siemens Brothers Dynamo Works, Ltd. Pp. xiv+201. (London: C. Griffin and Co., Ltd.) 10s. 6d. net.

Einführung in die Spektrochemie. By Prof. G. Urbain. Pp. viii+213+9 plates. (Dresden and Leipzig: T. Steinkopff.) 9 marks.

The Oxford Geographies:—A Commercial Geography of the World. By O. J. R. Howarth. Pp. 236. (Oxford: Clarendon Press.) 2s. 6d.

DIARY OF SOCIETIES.

THURSDAY, JUNE 12.

ROYAL SOCIETY at 4.30.—Recent Researches on the Palatine in Relation to Geology, Ethnology, and Physics: Commendatore Boni.—The Growth and Sporulation of the Benign and Malignant Tertian Malarial Parasites in the Culture Tube and in the Human Host: J. G. Thomson and D. Thomson.

MATHEMATICAL SOCIETY, at 5.30.—The Electromagnetic Force on a Moving Charge in Relation to the Energy of the Field: Sir J. Larmor.—Einige Ungleichungen für zweimal differentierbare Funktionen: Prof. E. Laudau.—(1) The Fractional Part of $n^k\theta$; (2) The Trigonometrical Series Associated with the Elliptic θ-functions: G. H. Hardy and J. E. Littlewood.—A Proof that every Equation of Degree n has n Roots Real or Imaginary: W. N. Roseveare.—The Evaluation of a Certain Definite Integral: J. Hammond.—Foucault's Pendulum: Dr. T. J. I'A. Bromwich.

FRIDAY, JUNE 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Note on Variable Stars of Cluster Type: H. C. Plummer.—The Determination of Maxima and Minima of Variable Stars of Long Period: M. E. J. Gheury.—A Photographic Determination of the Proper Motion of 250 Stars in the Neighbourhood of Σ 443: A. A. Rambaut.—The Planet Jupiter in 1890: A. Stanley Williams.—The Origin of Solar Electricity: J. A. Harker.—Note on a Method of Balancing Dome Shutters: W. H. Maw.—Devices for Subtabulation: T. C. Hudson.—Some Spectrographic Measures of the Solar Rotation at the Kodaikánal Observatory: J. Evershed and T. Royds.—Preliminary Results of Observations made with the Cookson Floating Zenith Telescope: A. S. Eddington.—*Probable Papers:* The Spectrum of Nova Geminorum No. 2, 1912, April, and 1913, February–April: Rev. A. L. Cortie.—The Position of the Sun's Axis as Determined from Photographs of the Sun from 1874 to 1912: F. W. Dyson.

MALACOLOGICAL SOCIETY, at 8.—Note on the Genus Pseudomalaxis, Fischer, and Descriptions of a New Species and a New Subgenus: Marqués de Monterosato.—Note on the Freshwater Mollusca found with *Unio Auriculatus*, Spengl, at Barn Elms, Surrey: A. S. Kennard and B. B. Woodward.—The Land Mollusca of the Kermadec Islands: Tom Iredale.—Definitions of Further New Genera of Zonitidæ: G. K. Gude.

PHYSICAL SOCIETY, at 8.—Some Experiments on Tinfoil Contact with Dielectrics: G. E. Bairsto.—A Method of Measuring the Pressure of Light by Means of Metal Foil: G. D. West.

MONDAY, JUNE 16.

VICTORIA INSTITUTE, at 4.30.—From Suez to Sinai: A. W. Sutton.

TUESDAY, JUNE 17.

MINERALOGICAL SOCIETY, at 5.30.—The Crystal habit of Topaz from New Brunswick, Canada: H. V. Ellsworth.—(1) The Meteoric Stone of Baroti, Punjab; (2) Mineralogical Notes: Dr. G. T. Prior.—Photographs illustrating Crystal-structure as Revealed by Röntgen Radiation: W. L. Bragg.

ROYAL STATISTICAL SOCIETY, at 5.—The Trade of the British Empire: Simon Rosenbaum.

WEDNESDAY, JUNE 18.

ROYAL MICROSCOPICAL SOCIETY, at 8.—(1) The Measurement of Working Aperture; (2) A Method of Investigating Diatom Structure: Hamilton Hartridge.—The Higher Bacteria (Sphaerotilus). E. Moore Mumford.—The Structure of the Nucleus: E. J. Sheppard.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—Pilot Balloon Observations in Barbados, 1910–1912: J. S. Dines.—The Harmattan Wind of the Guinea Coast: H. W. Braby.—The Correlation of Rainfall: J. Peek and Dr. E. C. Snow.

THURSDAY, JUNE 19.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Atomic Specific Heats between the Boiling Points of Liquid Nitrogen and Hydrogen. I. The Mean Atomic Specific Heats at 50° Absolute of the Elements a Periodic Function of the Atomic Weights: Sir James Dewar.—An Active Modification of Nitrogen produced by the Electric Discharge. V.: Hon. R. J. Strutt.—The Electrical Emissivity and Disintegration of Hot Metals: Dr. J. A. Harker and Dr. G. W. C. Kaye.—A Method of Measuring the Viscosity of the Vapours of Volatile Liquids, with an Application to Bromine: Dr. A. O. Rankine.—The Efficiency of Selenium as a Detector of Light: E. E. Fournier d'Albe.—Synthesis of the Anhydrides of α Aminoacyl Glucosamines: A. Hopwood and C. Weizmann.—The Flexure of Telescope Mirror-discs arising from their Weight, and its Influence upon Resolving Power: H. S. Jones.—(1) A Condition that a Trigonometrical Series should have a certain Form; (2) Trigonometrical Series the Cesaro Partial Summations of which Oscillate Finitely: Prof. W. H. Young.

LINNEAN SOCIETY, at 8.—Impressions of the Feeding-tracks of *Limax maximus* and *Helix aspersa*: Mrs. Longstaff.—African Species of the Genus Crotalaria: E. G. Baker. Aphareocaris, nom. nov. (Aphareus, Paulson), a Genus of the Crustacean Family Sergestidæ: Dr. W. T. Calman.—Water-colour Drawings of Australian and South African Plants: Miss Fuller.—An Anatomical Study of the Cone-genus Lepidostrobus: Dr. Agnes Arber.—Fresh-water Rhizopoda from North and South America: G. H. Wailes.—A Revision of the Genus Symphytum, Tourn.: Cedric Bucknall.—Some New British Plants: Dr. C. E. Moss.

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NATURE

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THURSDAY, JUNE 19, 1913.

MENDELISM AND STOCK-BREEDING.

The Principles of Stock-Breeding. By Prof. James Wilson. Pp. vii+146. (London: Vinton and Co., Ltd., 1912.) Price 5*s.* net.

IN this volume Prof. Wilson claims "to deal with the problem of stock-breeding in the light of the Mendelian discovery." The book is addressed to breeders; for the sake of clearness it is shorn of many words common to the writings of the modern exponent of this branch of biological science, and it is clearly designed to stimulate the practical breeder to base the conduct of his business on Mendelian principles.

A book from the pen of Prof. Wilson is sure to command attention, and in this instance he brings abundant enthusiasm to help him in his task, and is full of hope for the future. We are not convinced, however, of the wisdom of the undertaking; neither scientific enthusiasm nor hope appeals forcibly to the practical man; he requires facts on which to base his work. The author himself demonstrates that very few facts applicable to the breeding of domesticated animals are yet to hand, and it seems to us that the time has not yet come when breeders as a whole can reap substantial benefit from the theory of Mendel.

The enthusiastic Mendelian may, perhaps, consider that he has effectively disposed of the opinion of many biologists that Mendelism has not yet been proved to be the main road, has merely been shown to be a side track alongside that road which leads to the solution of the mysteries of heredity and variation. But the practical breeder is aware of this scientific scepticism; he is even more difficult to convince than is the pure theorist, and we doubt if the examples of applied Mendelism which Prof. Wilson gives will serve to stimulate his belief in the practical value of that theory.

There are three main reasons why the application of Mendelism to stock-breeding is rendered difficult: time, cost, and trustworthy data. To-day we have a very meagre allowance of data, and the little we have is rarely trustworthy. In order to gain such data many years must pass, and many wealthy breeders must content themselves with the collection of facts which shall be recorded in great detail. This knowledge must be gained by exceedingly careful observation of the results obtained by breeding on a definite plan and on a large scale, and the records must be designed to embrace the conduct of a number of characters which may in themselves be exceedingly difficult to observe; and when the facts are known they must be applied.

The author gives an instance of such application. "Assume," he says lightly, "that sixty-four heifer calves are got, because this is the smallest number that will split into all the possible cases"; of these, only one can have the characters desired, and these characters can only be fully determined after the animal has grown up. But in order to get such a herd of heifer calves a much larger number must be bred; and suppose this heifer dies before she reaches maturity, or suppose she proves to be sterile! Is this a problem which is likely to attract any but a very rich and a very large breeder? One may grow wheat on an infinitely larger scale at a nominal cost, but the breeding of stock in sufficient numbers is a very different matter, as Raymond Pearl's experiments clearly show. It is true the author adds that "In practice such a number need not necessarily be bred, because from a smaller number the desired stock could eventually be raised." But he does not define what he means by "eventually," and it seems that the element of chance must have a large share in the calculation.

In the early part of the book, Prof. Wilson gives a lucid account of the old theories of stock-breeding. We scarcely think, however, that he does full justice to some of the experimental work done in those days, and cannot agree with some of the deductions he draws from his study of the subject; as, for instance, in the degree of attention paid by the old breeders to the part played by the sire, and, if we understand him aright, in the relation of artificial selection to evolution.

The chapter on the Mendelian theory and animals is another instance of the author's power of exposition. In spite of great difficulties, he has surely made this part of his subject clear to his readers. In doing so he has emphasised the fact that when you can apply Mendel's theory to observed phenomena you may thus obtain valuable knowledge of the forces which act in order to produce those phenomena, and he shows that to this extent you will gain a clearer view of their significance.

But if this is all the help Mendelism will give to breeders there will undoubtedly be much disappointment shown by those who have been led to expect that it will serve as a short cut to the production of improved breeds, and for the modification of special characters; that it will take the place of those laborious methods of selection hitherto practised by the few successful breeders—who are born with an eye for the detection of minute variations, and can afford to fail many times—and thus put success within the reach of all.

In our opinion, much more research and many practical experiments on a large scale are needed before a book on the practical advantages to be derived from Mendelian methods can, with advantage, be presented to breeders, since premature assertion of the utility of a theory tends to alienate the practical man, and to destroy his confidence in the value of science.

THE INDEXING OF CHEMICAL LITERATURE.

General Index to the Chemical News. Vols. i to c. Pp. 712. (London: *Chemical News* Office, 1913.) Price 2*l.*

IN compiling an index of chemical literature on anything like a large scale numberless difficult problems are encountered at the outset. The question as to whether authors and subjects should be divided or not is usually answered in the affirmative and with good reason. The inquirer generally knows whether he wishes to refer to an author's name or to some subject, and it is undoubtedly a help to be able to turn with certainty to one section or the other.

The mere alphabetical arrangement of authors' names would appear to be simple, but the greatest difficulty is often experienced if any effort is to be made to secure that individual authors are to be properly identified with their work.

An index of subjects offers even more problems to be considered. Over an extended period of years, changes of nomenclature are bound to occur, and the same compound is often described under two or even three synonyms. Is the indexer to record the names as they stand, or is he to use the modern name only, and index all older varieties or synonyms under that? In view of the fact that authors rarely know even the rudiments of nomenclature, and seldom consider whether it is correct to write, *e.g.*, caustic soda, sodium hydrate, or sodium hydroxide, it would appear that the only possible thing to do in such a case is to decide on "sodium hydroxide," and index all references to "caustic soda" or "sodium hydrate" under it. With organic compounds the case is much more difficult, but the point has, perhaps, been sufficiently illustrated.

The index under review is one that will be necessary to every reader of the *Chemical News*, and, indeed, will be useful to all chemists, giving, as it does, references to so many subjects, such as university intelligence, &c., which are found in perhaps no other chemical journal.

The advisability of putting authors and subjects together is a matter of opinion, but the searcher after names will turn over with some impatience the 35 pages which separate "Bonz" and "Booth."

The identification of certain authors—for example, "Mr. Brown" and "Dr. Schmidt"—must be difficult, as there are twenty-nine "Browns" and twenty "Schmidts." This, of course, illustrates a common failing of authors of not putting their full names to their papers.

The German "ü" is taken as "u" throughout. This, we believe, is the custom of the British Museum, but to mix up "Mullers" and "Müllers" is, in our opinion, obviously incorrect.

As regards the subjects the list of books reviewed, which occupies the thirty-five pages just mentioned, is very valuable, and so are the collected references to many other matters of general chemical interest, but it is really regrettable that some effort has not been made to avoid duplicate headings; this is the chief fault we have to find with the book. Under "acids" we have "chlorhydric" and "hydrochloric," "cyanhydric" and "hydrocyanic," "naphtholsulphonic" and "naptholic sulpho," "bioxybenzoic," "dioxybenzoic," and "dihydroxybenzoic," with no cross-references from one to the other. Entries are also to be found, again without cross-references, under acid, carbolic, and phenol, aldehyde, anisic, and anis-aldehyde, alizarin, nitro-, and nitralizarin, carbamide and urea, benzalacetophenone and benzylidene acetophenone, benzene, benzine, and benzol, carbon bisulphide, disulphide, and sulphide, and many others.

Cross-references there are indeed, but many are unnecessary; particularly "Amyl-diethacetate, cinn-. See Cinnamyldiethacetate."

In a work of this kind misprints are almost inevitable, but a little more care in the proof-reading might have avoided such mistakes as "alikali earth metals," "alsohols," "eperiments," "methylsalysilic," &c.

J. C. C.

PETROLOGY AND BUILDING STONES.

(1) *The Petrology of the Sedimentary Rocks.* By Dr. F. H. Hatch and R. H. Rastall. With an Appendix on the Systematic Examination of Loose Detrital Sediments by T. Crook. Pp. xiii + 425. (London: George Allen and Co., Ltd., 1913.) Price 7*s.* 6*d.* net.

(2) *Building Stones and Clay-Products: A Handbook for Architects.* By Prof. Heinrich Ries. Pp. xv + 415 + lix plates. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1912.) Price 12*s.* 6*d.* net.

(1) SINCE the days of Sorby much useful work has been done on the less-altered sedimentary rocks—by Hill, Jukes-Browne, and Hume,

for example, on the Cretaceous; Wethered on the Carboniferous; Hutchings on slates and other rocks, Millard Reade and Thomas on the Trias; Cayeaux on many formations, to mention a few only of the workers. Yet, on the whole, the petrological problems of sedimentary rocks have not attracted the attention of geologists with anything like the same force as those presented by the igneous rocks.

The reasons for this partial neglect are not far to seek. Most active, perhaps, has been the influence of the "path of least resistance." It has been much easier to make a brave show for a given expenditure of time and care on the petrology of igneous than on that of sedimentary rocks. Though many sediments, especially when much metamorphosed, may be studied in thin sections, the examination of less compact sediments requires the handling of a considerable bulk of material by somewhat tedious processes, as well as the application of a sound knowledge of the methods of mineral identification. Thus we find the fresher sediments passed over in favour of their most highly altered representatives, which have received a very large share of attention.

It is therefore a matter for congratulation that we have now, for the first time, a book (1) devoted to the petrology of the sedimentary rocks, and, further, that it is a companion to Hatch's "Textbook of Petrology," which has a well-earned reputation for lucidity of treatment.

The book is divided into two parts, the first dealing with the mode of formation and materials of raw sediments (employing this term in its widest sense, to include all but rocks of igneous origin), the second with their metamorphosed equivalents.

In the former the subject-matter is treated on familiar lines under the heads deposition in general, fragmental deposits, chemical deposits, organic deposits. The clastic sediments are graded according to the dimensions of their constituents, *e.g.* boulder and scree deposits, above 100 mm. diameter; gravel, between 2·5 and 100 mm.; sand, between 0·05 and 2·5 mm.; mud and dust, below 0·05 mm.

It seems a little unreasonable to describe the foraminiferal, pteropod, diatom, and radiolarian oozes with the fragmental deposits, while shell and coral formations appear in the organic deposits.

Here and there, as is usual in text-books, difficult ground is lightly tripped over; the explanation of the formation of "iron-pan" is not all that could be desired.

From fresh sediments the authors pass on to what they call the metamorphic derivatives, and follow Van Hise and many modern writers in the assumption that metamorphism must be taken to connote any change in the constitution of any kind of rock, through whatever agency. This is logical, no doubt, but "horse sense" is sometimes better than any amount of logic; by being so precise about the *literal* meaning of the word, its old-fashioned and quite useful significance has been destroyed. By their acceptance of this extended usage of "metamorphism," the authors stultify in a measure their own classification. Why should they trouble to separate the "sediments" from their "metamorphic derivatives" when they must be aware that the former are suffering, from the earliest moments of their formation, those very changes of constitution that produce the so-called metamorphism. There can be no unmetamorphosed rocks if metamorphism is what the authors say it is. However, coming to details, we find this subject treated under the heads contact metamorphism, regional metamorphism, cementation, metasomatism, and weathering. The "zone of cementation" is said to be permanently saturated with water-solutions, but we would point out that cementation may take place in the "zone of weathering," and, indeed, numerous examples are given in the book.

This volume contains little that cannot be obtained by the perusal of the larger general textbooks; none the less, it will be a convenience to students to have the information in this handy form. In a new edition, which we hope will soon be required, we should like to see more illustrations of typical rocks as good as those in the present work; photomicrographs of metasomatic and other structures in limestones and series to illustrate progressive alteration in contact and regional metamorphism are specially to be desired. The value of this volume is greatly enhanced by the admirable appendix on the systematic examination of loose detrital sediments by Mr. Crook.

(2) Prof. Ries is as well known in this country as in the United States for his numerous and valuable works on clays. There is little that is new in his book on building stones and clay-products, but it is well produced, and compiled by an experienced hand; it will doubtless be appreciated by the United States architects, for whom it has been written. The viewpoint throughout is entirely American, as the following extract from the glossary will illustrate: "*Forest-marble*, an argillaceous limestone in which the colouring-matter is so disposed as to resemble forests."

OUR BOOKSHELF.

The Log of H.M.S. Encounter. Australian Station, 1910–1912. By Herbert Wilson. (London: The Westminster Press, 1912.)

IT may be more often than is generally known that a petty officer in his Majesty's Navy keeps a private log; it may be seldom that such a log sees daylight in the form of print; but it is approaching a unique occurrence when such a log is published in book form, and records in considerable detail a complete story of an eclipse expedition.

The particular log to which reference is here made is that of H.M.S. *Encounter*, covering the period 1910–12. In this period, which was her last commission on the Australian station, the total solar eclipse of April, 1911, occurred, and for that event she was placed on special service to assist the British and Australian expeditions; needless to say she did signal service on that occasion.

It may be remembered that Dr. W. J. S. Lockyer and the Rev. Father Cortie, S.J., were in charge of the British parties, while Mr. Baracchi was chief of the Australian contingent. All the parties went to Vavau, one of the islands of the Tonga group, but the British expeditions from England were conveyed from Sydney to their station by H.M.S. *Encounter*.

The author of this book is not only an excellent observer, but, further, he can commit his observations clearly to writing. The account of his experiences at the eclipse station is only one of many incidents which he records in an interesting manner in these pages. To take an example in other fields, he writes:—"We ran into a great storm area—great atmospheric disturbances. There were intermittent downpours of rain, accompanied by great rolls of thunder and most vivid lightning—in fact, a magnificent, typical tropical storm." Being a practical man, he further narrates: "We always take advantage of times like this to wash our dirty clothes in nice soft rain water." Halley's comet was first recorded by him in his entry of March 21 (1910), and he subsequently makes numerous remarks as to its appearance on different occasions.

This log is accompanied by numerous reproductions from photographs taken by his shipmates, and the volume forms not only a valuable memento to those who served through the commission with him, but an interesting survey of a petty officer's life on and off duty.

The Statesman's Year-Book: Statistical and Historical Annual of the States of the World for the Year 1913. Edited by Dr. J. Scott Keltie; assisted by Dr. M. Epstein. Pp. xcvi + 1452 + 10 plates. (London: Macmillan and Co., Ltd., 1913.) Price 10*s*. 6*d*. net.

"THE Statesman's Year-Book" with the present issue reaches its fiftieth year of publication, and by way of signalising this event certain new features are added which not only are appropriate to it, but also enhance the utility of the work. A number of statistics for the British Empire and for the other principal countries are furnished to afford comparison between the conditions of years about 1860 and of the present day. There is a semi-tabular retrospect of recent history. Certain comparisons covering the same period also appear under the individual headings of some of the countries. Map-work also plays an important part; there are maps, side by side, of each continent for the years 1863 and 1913; on some of these (*e.g.* Europe and America) the graphic representation of railway extension is perhaps the most noteworthy feature; from the maps of Africa we have evidence at a glance of the wonderful extension of exploration in the half-century. The year-book always deals exhaustively with the subject of defence, and we now have diagrams illustrating the "growth of displacement, horse-power, and speed of capital battleship types," and the "varying ratio between weight of heaviest gun, its penetrative power, and the protection afforded to ships," during the last fifty years.

It is scarcely necessary to say that the accustomed features of the book are maintained at their usual standard: the Franco-Spanish treaty is dealt with by means of both map and text, and in the same way the recent important extensions of Ontario, Quebec, and Manitoba are indicated. The introductory matter further includes a variety of valuable detail such as the substance of the treaty of Ouchy, a table of cases brought before the Hague tribunal, and material dealing with the naval and land defences of the British Empire. It is clear that in making up this book the problem of space is very carefully watched, and even the important additions mentioned here have not caused the volume to become unwieldy.

Cambridge County Geographics: Lincolnshire. By E. Mansel Sympson. Pp. viii + 193. (Cambridge University Press, 1913.) Price 1*s*. 6*d*.

DR. SYMPSON'S account of Lincolnshire is unusually interesting, and will appeal in many ways to scientific readers. The geology, natural history, climate, and peoples are all dealt with as fully as the limited space allowed. Honourable mention is made, among the distinguished men produced by the county, of Sir Isaac Newton, Sir Joseph Banks, and Sir John Franklin. Altogether the volume well maintains the high standard of the series.

Atlas Notes. By J. C. Chute. Pp. 82. (London: Humphrey Milford, Oxford University Press, n.d.) Price 1*s*.

"THESE notes are intended as a guide to a revision of the subject, for boys who have dabbled in its various departments and who now wish to make good their knowledge of the chief facts contained in a good political and physical atlas," says the author in his preface. If boys are set to study geography in school they should not be allowed "to dabble," but should be encouraged to work methodically and with all the thoroughness the time available permits. In that case the boys would themselves make the notes required for any future revision, which is better than having them already made.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Pianoforte Touch.

I HAVE read Prof. Bryan's piano-player article in NATURE, and wish to congratulate him on seeing so early the wonderful capacity of the pneumatic player. I entirely agree with him. Long ago I have done work like his, though very crudely. Thus I always played with the *feet*, sitting on a pivoted swinging chair, and I constructed an arrangement in which, by means of two strings, I had some control of the touch. It was a partially successful attempt at most. I also fixed up a "dead stop" string operating a brake on the engine, by which pauses could be made at the proper places. I am sure Prof. Bryan's way is immensely superior.

It is very singular that some of the compound touch problems are of a transcendental nature. They cannot be solved by common, rigorous mathematics, but only by my new mathematics. At Prof. Perry's suggestion I made this a feature of one of my books. It was full of compound touch problems insoluble (so I was told) by rigorous mathematics, though the rigorous mathematicians cannot deny the results. It is because their ideas concerning functions are not broad enough. I have also been thinking about the theory, and think it will be more difficult than appears in Prof. Bryan's paper, because his touch variations are secondary to those of the player itself, due to the way the holes are cut and their overlap in the music-rolls. The results are sometimes not good. Another thing, I have considered the piano itself to be a rather imperfect instrument. We get used to its faults; is that any reason they should be made virtues?

I consider the piano-player does for music what the printing press did for books. But while, after reading a book once, you generally never wish to read it again, it is impossible to appreciate elaborate technical compositions without playing them over and over again. So there is something to be said for the playing by children and men even in the most mechanical and unintelligent way.

OLIVER HEAVISIDE.

A Peripheral Effect with X-Radiation.

WHILST repeating the now well-known experiments of Barkla, Laue, and others we have accidentally met with some remarkable effects upon which we should like to invite judgment. By inadvertence the edge of a piece of mica intercepted a direct beam of X-rays, and the recording photographic plate shows pronounced black and white bands along the X-ray shadow of the edge of mica. Further experiments with mica, glass, and metals also gave the effect, the edge of the shadow being bounded by a well-defined black band in the dark portion of the field with a light band in the lighter half.

An extended series of experiments was then made using lead foil cut into thin strips from one to five layers in thickness, mounted on glass, and placed in the direct beam of X-rays; no screen of any kind being employed, as was the case in the preliminary experiments. The distance of the photographic plate, placed behind and parallel to the mounted pieces of lead, was varied from 3 mm. to 5 cm., and that of the anti-kathode to the obstacle from 26 to 450 cm. Under these varied conditions of distance dark and light bands along the edges were obtained on the negative. The X-ray bulb had a fine focus, and exceedingly sharp X-ray shadows were obtained, especially at distances between 200 and 450 cm., a fact to which the observance of these bands is greatly due.

The width of the bands in these lead strip experiments is roughly 0·1 to 0·2 mm., but in the preliminary mica and glass experiments they were much broader, being about 0·5 mm. in width. These bands are distinctly visible under a low-power microscope, whilst under favourable conditions of illumination they are plain without artificial aid, and the same remarks apply to their prints. They are seen also when thrown upon a screen, and these facts seem to preclude the suggestion of their being contrast or optical effects, as was supposed by Haga and Wind in their well-known attempts to demonstrate diffraction. That they are not diffraction effects comparable with those of light is shown by their not varying appreciably in width as the photographic plate is varied behind the mounted strips of lead foil. Nor should these bands be confounded with those which appear upon the portion of the beam reflected from crystalline surfaces (which we also obtained), and have been described by de Broglie and Lindemann; although we are disposed to admit a possible physical connection.

Bands of similar width and appearance have been obtained with other metals, such as iron, zinc, copper, and aluminium, and in one case where an attempt was made to obtain direct refraction the white band appears between the transmitted and the direct beam. The apparent constancy of width and appearance under widely different conditions is a baffling point, arguing *prima facie* an optical or photographic effect. Yet against this is to be set the fact that so far mica and glass have given bands several times as wide as those from metals.

Attempts to vary the bands from metals by passing electric currents through them, and by high temperatures, have given so far negative results, though it may be desirable to mention the fact that in the latter case images of cold wires appear distinctly brighter in the negative. In one experiment, in addition to bands, a remarkable halo appears at a distance of 1·9 cm. from the image of the circular orifice in a metal screen. In another case a black band of approximately equal intensity to the image given by the direct beam appears surrounded by a white area, and in the same position, *i.e.* between the direct and reflected images. The fact that this band is black in the negative shows that the effect cannot be due to absence, in this position, of the generally scattered radiation which may have fogged the plate.

An explanation of grounds of halation, or reflection from the back of the plate, is, we need scarcely say, inconsistent with the accepted theory of X-radiation. The solution to which we may be reduced is that the bands are due to some edge or peripheral condition of the substance depending upon abrupt discontinuity of the media (mica, air), since a mere scratch or break in the surface does not produce the bands. Increase of density along the edges due to surface tension would appear to be of too small an order to account for the phenomenon. A subjective appearance of bands may invalidate some of the cases with metals, but in others (especially that with a halo suggestive of an X-ray spectrum) actuality is beyond doubt.

W. F. D. CHAMBERS.
I. G. RANKIN.

90 Gordon Road, Ealing, W.

Radium and the Evolution of the Earth's Crust.

It is now well known that if the proportion of radium in the interior of the earth is the same as that in the surface rocks, the earth ought to be growing hotter, and the temperature gradient of the crust ought to be much higher than we find it. A simple calculation shows that a distribution of radium averaging 2×10^{-14} grams in each gram of rock throughout the earth would suffice to preserve thermal equilibrium. The amounts of radium actually found in the surface rocks are approximately as follows:—

Acid	...	...	3×10^{-12} grams per gram
Intermediate	...	2	" " "
Basic	...	...	1 " " "
Ultrabasic	...	0·5	" " "

In addition to the elements of the uranium family, those of the thorium family must also be considered, for they afford an equally important supply of heat.

Prof. Strutt was the first to indicate the way in which the obvious dilemma might be escaped. In order that the earth should be nearly in thermal equilibrium (*i.e.* not growing hotter, but cooling at the very slow rate allowed by the radio-active elements as they decrease in quantity in accordance with their progressive disintegration), it is necessary to assume that the earth's store of radium is concentrated near the surface. As the following arguments indicate, this conception is less arbitrary than would appear at first sight. The radio-active elements are found most abundantly in the acid rocks, their more basic associates being less embarrassingly rich. The more acid rocks are characteristic of only the outermost zones of the crust, and there are many reasons for believing that with depth the more basic rocks largely predominate. Seismic and other terrestrial phenomena have now provided us with data from which the condition of the earth's interior may be deduced with some confidence. First, there is the crustal zone, rapidly becoming less silicic with depth, having a mean density of 2·8, and an approximate thickness of thirty miles. Within a fairly sharp surface of discontinuity comes what may be called the stony zone. The density is 3·4, and judging from the close analogy presented by meteorites, the material would be of ultra-basic composition. This zone dies out at a depth variously estimated at from 600 to 900 miles. The internal core of the earth is probably largely composed of iron, its density being about 8.

In a number of meteorites, the radium content has been determined by Prof. Strutt and the present writer, and if it may be assumed that they afford a clue to the problem, the heavy metallic core should be completely destitute of radium, and the stony zone should contain only a small proportion, very much less than that of the ultra-basic rocks of the crust.

On the planetesimal hypothesis, the two internal zones find a ready explanation. It is supposed that the earth began as a nebulous knot, and that it has grown up to its present mass by the capture of associated planetesimals. It is very unlikely that as a whole it was ever in a molten condition. Internal heat probably arose largely from the condensation of the mass during the period of its growth. The temperature would slowly rise until the fusion point of certain of the constituents was reached, and the liquid tongues and pockets thus formed would tend to move away from the centre, the lighter and less viscous stony material being squeezed outwards relatively to a network of the heavier and more rigid metallic materials. Once vulcanism had been initiated in this way, the process would continue until a highly metallic nucleus had collected. Surrounding it there would gradually form a thick zone of silicate rocks, the differentiation from the original heterogeneous mixture of stony and metallic constituents being due to the selective fusion of the former. There seems to be little doubt that the radio-active elements would be concentrated in the stony zone. With the establishment of ocean and atmosphere, a new factor in surface differentiation arose, and sedimentary rocks were deposited for the first time. In some way which, as yet, we understand but vaguely, both igneous and denudational differentiation then combined in developing the earth's crust. We now find in the latter all those rocks which hold a maximum content both of silica and of the radio-active elements. The relative concentration of these constituents having taken place at the expense of the zone below, the conjectural paucity of the latter in radium finds a suggestive explanation.

Before the advent of radium, geologists had not recognised the difficulties presented by the peculiar chemical constitution of the earth's crust. Radium did not create this difficulty, but has merely directed attention towards it. Any explanation of the high percentage of silica in the surface rocks will explain equally well their richness in radium.

It can scarcely be said now that radium has given us "a blank cheque on the bank of time." Not only did the discovery of radium destroy the validity of the older thermal arguments, but also it led directly to the elaboration of a new and more refined method. Every radio-active mineral may be regarded as a self-contained hourglass, the radio-active end-products, helium and lead, slowly accumulating at the expense of their ultimate parent, uranium. In the few cases which up to the present have been investigated, periods of enormous duration have been revealed, and the geologist who ten years ago was embarrassed by the shortness of the time allowed to him for the evolution of the earth's crust is now still more embarrassed by the superabundance with which he is confronted. The time scale up to date, as determined by the lead ratio, is as follows:—

Carboniferous	... ...	340 million years
Devonian	... ...	370 "
Ordovician	... ...	430 "
Algonkian	... ...	1000 "
Archæan	... ...	{ 1300 " / 1600 " }

We must not moan over the apparent difficulties with which the geologist has been faced since the advent of radium. Rather should they be welcomed in that they open the way for further advances. If at present some of our ideas are mutually incompatible, the discrepancies do not demand a wholesale rejection of the facts, but simply a re-interpretation of the fundamental hypotheses on which so many of our doctrines seem to hang.

ARTHUR HOLMES.

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An Amphipod Invasion.

Many specimens of a small amphipod crustacean, *Euthemisto compressa*, Goës, have been forwarded to me by Mr. T. H. Nelson, of Redcar. On May 23 and 24 these were washed ashore in incredible numbers on the coast of Yorkshire, where they lay from Saltburn to Teesmouth—a distance of ten miles—in drifts several inches deep. The pools were alive with the crustaceans, and to the east of Redcar a fisherman was seen raking them into heaps, and wheeling away barrow-loads to put on his garden as manure. In the sea hundreds at a time could be scooped up in one's hands.

Euthemisto compressa is an uncommon British species recorded sparingly from a few localities, but off Redcar it occasionally appears in extraordinary shoals in springtime. Such visitations have occurred previously in the second week of February, 1892, April, 1907, and April 2, 1908. In general the creatures come ashore after a N. or N.E. wind, but on the present occasion a gentle westerly wind had prevailed for a few days. I should be glad to receive information from naturalists or fishermen who may have observed these minute "shrimps" about the same date, on other parts of the coast or in the open sea, so that knowledge may be gained of the full extent and of the provenance of the shoal.

JAMES RITCHIE.

Royal Scottish Museum, Edinburgh.

New Zealand Vegetation.

IN NATURE for April 10 (p. 147), under the title "New Zealand Vegetation," I notice the following sentence:—"The northern rivers and estuaries display a mangrove vegetation—a unique and unexpected occurrence outside of the tropics."

The writer of the article is evidently not aware that mangrove formations are found at intervals all round the coasts of Australia. The species which forms them is *Avicennia officinalis,* L., which occurs in all the Australian States, but not in Tasmania. It reaches its southerly limit in Western Australia in the neighbourhood of Bunbury ($33\frac{1}{2}°$ S.), where the trees reach a height of about 12 ft. On the east coast it is most familiar on the shores of the Parramatta River in Sydney Harbour, which is a little further south than Bunbury, but it occurs so far south as Corner Inlet, on the east side of Wilson's Promontory (39° S.). This southernmost point of the Australian continent is one degree further south than any point on the north coast of the North Island of New Zealand.

W. B. ALEXANDER.

The Western Australian Museum and Art Gallery, Perth, Western Australia, May 10.

I FEAR that in attempting to compress into a few paragraphs a general sketch of the plant communities of New Zealand I inadvertently conveyed the erroneous impression concerning the distribution of the mangrove vegetation in Australasia which Mr. W. B. Alexander has corrected in his interesting note. The sentence which he quotes is perhaps less misleading if read in connection with that immediately preceding it, and containing the statement upon which I wished to lay chief stress in enumerating the main types of New Zealand vegetation—"to find an equal variety a continent extending to the tropics would have to be visited." I was quite aware of the well-known fact that the eastern or Indo-Malayan mangrove flora, well developed on the northern littoral of Australia, extends in an impoverished form along the eastern and western coasts southwards, though it is interesting to note that it actually reaches the most southerly point of the Australian continent. It may be added that Prof. Bews (Annals Natal Museum, ii., 1912, p. 297) has recently described what appears to be the most southerly extension of the mangrove vegetation on the opposite side of the Indian Ocean, in Durban Bay; here, as in the subtropical and warm temperate parts of Australasia, the rich eastern mangrove flora is represented by an interesting though poorly developed outlier consisting of *Avicennia officinalis, Bruguiera gymnorhiza,* and *Rhizophora mucronata.*

F. C.

Anthelia.

IN connection with the correspondence in NATURE on the bright light on dew round the shadow of one's head, the accompanying photograph, which shows the phenomenon on dew on seakale, may be of interest. It was taken here on October 7, 1899, at 8.35 a.m. It shows the shadow of the camera, so that in spite of the irregularity of the leaves the radius of the

bright light is easily measured as nearly 8°. The scale of the photograph is 8·5° to the inch.

T. W. BACKHOUSE.

West Hendon House, Sunderland, June 10.

Antennæ for Wireless Telegraphy.

I WAS interested to see Mr. Campbell Swinton's letter on wireless receiving with his bedstead as an aërial. Many of the more powerful stations are, however, much easier to receive than is generally supposed; for instance, I have been able to read the Eiffel Tower nine o'clock news message with only 12 ft. of No. 18 S.W.G. copper wire stretched across my attic (second floor, about 25 ft. from the ground) using good earth to waterpipes, with usual tuning coils and condensers, bornite-zincite detector, and very sensitive 4000 ohm telephone (H. W. Sullivan), without any relay. Even when the aërial was reduced to 6 ft. of wire the signals were just audible, but very faint.

ARNOLD G. HANSARD.

Limpsfield, Surrey, June 10.

SOME months ago, in endeavouring to reduce the antenna to the smallest possible dimensions, such as by placing a series of wires just over the instruments, I found that by using a bedstead (without wire mattress) signals of "strength 8"—*i.e.* moderately loud—could easily be obtained from Paris *without the aid of a Brown relay*—a costly instrument, reputed to increase the strength of signals five times. The apparatus used was simply the orthodox loose coupling with crystal detector. The bed used is on the second floor of my house, about 20 ft. from the ground, and the gas-pipe below the same floor served as an earth connection.

Under the same conditions Norddeich is usually readable, and sometimes Poldhu and Nauen. That nearer stations are also heard is obvious.

I should be pleased to give a demonstration of reception by means of this same bedstead as the antenna to anyone interested.

Benjamin S. T. Wallace.

113 St. James Road, Upper Tooting, London, S.W., June 16.

Sub-Red Crag Flint Implements and the Ipswich Skeleton.

I would like Mr. Sutcliffe to read p. 199 of vol. i., part ii., Proceedings East Anglian Prehistoric Society, which contains the original description of the discovery of the Ipswich man. I think it would have been better if he had done this before publicly accusing me of inconsistency in regard to this matter.

J. Reid Moir.

THE OXYGEN CONTENT OF THE ATMOSPHERE.[1]

THIS memoir, published under the auspices of the Carnegie Institution of Washington, is of a type with which we are becoming increasingly familiar—a publication, in fact, which, it may be argued, the institution was created largely to undertake. None of the regularly constituted scientific societies would probably charge themselves with the issue of such a work, and it is very unlikely that it would see the light if left to private enterprise. Nevertheless, it is an eminently useful work, and will be welcomed by chemists, meteorologists, and physiologists alike.

The work is divided into two parts. Part i. is wholly concerned with an historical account of the development of the methods for determining oxygen, in which practically everything contained in the literature has been put together and collated, from the days of Scheele and Priestley to those of Regnault and Bunsen, von Jolly and Morley, down to the methods of our own time depending upon purely absorptiometric processes. Naturally there is nothing very original in this section, and it is well-trodden ground to all who are familiar with the development of eudiometry. It is, however, an interesting and useful compilation, and will be of service to those who are concerned with accurate gasometric analysis, especially in relation to the atmosphere, or who desire to know all there is to know relating to its history.

The second and more immediately important part deals with the experimental work of the nutrition laboratory of the Carnegie Institution, Washington, of which Prof. Benedict is the director.

For some time past the nutrition laboratory has been engaged, among other things, in an elaborate inquiry into the nature of respiratory exchange in relation to metabolic processes, and the necessary instrumental equipment has now been brought to a very high degree of precision. After a careful investigation into the merits of the various types of modern absorptiometric apparatus, it was decided that the arrangement devised by Dr. Klas Sondén, of Stockholm, a development of the apparatus originally contrived some years ago by Prof. Pettersson, more fully fulfilled the essential conditions of expedition, convenience and accuracy than any other existing form; and part ii. is practically made up of a description of the Sondén air-analysis apparatus, illustrated by photographs and woodcuts, together with an account of the plan and methods of research to be undertaken by it, with the results which have been obtained up to the date of publication of the report.

The principle of the apparatus is essentially that of the original Pettersson instrument, in which the absorption and determination of the carbon dioxide and oxygen are made, as in the Hempel, Orsat, and Haldane arrangments, by means of caustic potash and alkaline pyrogallate, but with the use of water-jackets and compensating pipettes so as to ensure much greater accuracy of reading.

The plan of the research involved (1) the estimation of the comparative oxygen-content of uncontaminated outdoor air under all conditions as to wind direction and strength, temperature, cloud formation, barometer and weather, including rain, snow, fog and mist; (2) a study of the influence of the temperature of the reagent upon its absorptive power; (3) an examination of the air over the North Atlantic Ocean; (4) on the summit of Pike's Peak; (5) in the crowded streets of Boston and in the subways of New York and Boston.

Such a programme necessitated a very large amount of experimental work and the analysis of many hundred samples of air. In addition, a large volume of work was needed in control and verification, and especially in tracking down and eliminating sources of possible error. Eventually a routine method was established, and from a long series of determinations it would appear that, as regards oxygen content of outdoor air, no material fluctuation could be detected over a period extending from April, 1911, to January, 1912. This constancy was maintained in spite of all possible alteration in weather conditions, barometric or thermometric changes, or changes in humidity, wind direction, and strength; furthermore, the experiments were made before, during, and after the vegetative season. The average result of 212 analyses showed 0·031 per cent. of carbon dioxide and 20·952 per cent (corrected) of oxygen. Hence Dr. Benedict concludes "that air is a physical mixture with the definiteness of composition of a chemical compound." We have, in fact, got back to the position maintained by Cavendish in 1783 and by de Marli in 1787, that is, of the uniform constancy of the composition of normal atmospheric air, so far as regards its oxygen content.

Prof. Benedict further concludes that—

> While the combustion of fuel and the vital processes of men and animals result in a local increase in carbon dioxide and decrease in oxygen on the one hand, and vegetable growth results in a decrease in carbon dioxide and increase in oxygen on the other, the extraordinary rapidity with which the local variations in the composition of the air are equalised is accentuated by the observations on street air, which show but the slightest trace of an oxygen deficit.

[1] "The Composition of the Atmosphere, with Special Reference to its Oxygen Content." By F. G. Benedict. Pp. iii+115. (Washington, D.C.: Carnegie Institution of Washington, 1912.)

The interdependence between the amounts of carbon dioxide and oxygen is so constant that carbon dioxide estimations made in the Sondén apparatus may be taken as an accurate indication of oxygen content. For every 0·01 per cent. increase in atmospheric carbon dioxide, a corresponding decrease in the percentage amount of oxygen may be safely assumed. T. E. T.

THE POTSDAM METEOROLOGICAL AND MAGNETIC OBSERVATORIES.[1]

THE volume referred to below gives a lucid description of the observatories at Potsdam, compiled by Profs. Süring and Schmidt, who are in charge respectively of the meteorological and magnetic departments. A preface by Prof. Hellmann, the director of the Royal Prussian Meteorological Institute, to which the observatories belong, states that the book is primarily intended for the benefit of those studying at or visiting the observatories, the number of visitors being now large. The text describes the buildings and instruments, while reference is made in footnotes to many researches associated with the place. Thirty-one figures supplement the descriptions of buildings and instruments in the text, and a plate gives a ground-plan of the whole site.

The construction of the magnetic observatory began in 1888, and that of the meteorological observatory in 1890, so that the buildings are all modern. The equipment is also modern and exceedingly complete. The site on the Telegraphenberg, a wooded hill on the outskirts of Potsdam, might be criticised by some meteorologists, but it possesses much natural beauty, and the proximity of the astrophysical and geodetic observatories—also situated on the Telegraphenberg—admits of the ready exchange of ideas amongst a number of men of science, each an expert in his own subject. The figure reproduced shows the enclosure devoted to meteorological instruments, especially those recording air and earth temperatures and rainfall. The small building in the corner is devoted to atmospheric electricity. In the background is the main meteorological building, a very large and handsome structure. Its basement contains *inter alia* a physical and chemical laboratory, a photographic dark-room, a workshop, electrical generating apparatus and storage batteries.

Observation enclosure of the meteorological and magnetic observatories at Potsdam.

On the ground-floor are various rooms for meteorological work, including a large room containing the barographs and other recording instruments. Most of the remaining space under the roof serves to provide accommodation for the resident staff and the director of the Meteorological Institute, but it includes a library and a conference chamber. The roof is flat and surmounted by a low and a high tower, the former devoted to optical and cloud-measuring apparatus. The large tower rises to a height of 32 metres above ground-level. A staging on the top of it carries various wind-measuring apparatus, including a Robinson anemometer, the cups of which are 40·8 metres above the ground and surmount all other objects on the Telegraphenberg.

There are two chief magnetic buildings, the larger about 100, the smaller about 150 metres from the meteorological building. The former contains two sets of magnetographs, in a basement maintained at a nearly constant temperature throughout the year; the latter is devoted to absolute observations. In view of electric-tram disturbances in Potsdam—though these are still exceedingly small—a new magnetic observatory

[1] "Meteorologisch-magnetisches Observatorium bei Potsdam." Pp. 67+plates. (Berlin: Behrend and Co., 1912.) Price 3 marks.

was built in 1906 at Seddin, about 12 kilometres south-west of Potsdam. Magnetographs are now in operation there as well as at Potsdam under the Potsdam staff. A description of the Seddin buildings and instruments is thus included.

The volume contains much of interest to all meteorologists and magneticians, and is admirably suited for the purpose for which it was primarily intended. A previous study of it will double the advantages of a visit, while subsequent consultation will recall memories of a most pleasant and profitable experience. C. CHREE.

RECENT SEA-LEVEL VARIATIONS IN JAPAN AND ITALY.[1]

IN a valuable memoir, Prof. Omori deals with the variations in the height of the sea-level at nine mareograph stations in Japan from 1898 (in a few cases from 1894) to 1910, referred to in a note in NATURE of December 26, 1912 (vol. xc., p. 471). They are greatly in excess of any changes that might be due to variations of barometric pressure or air-temperature, and the effects of wind are probably negligible. These variations being allowed for, there remain considerable changes in the mean annual height of the sea-level at all nine stations, the greatest being a decrease in height of 22·7 mm. per year at Ayukama. In the accompanying sketch-map, the shaded areas represent the parts of Japan which are now subsiding, the boundaries inland being determined by interpolation. The figures at the different stations denote the mean annual rise or fall of the sea-level in millimetres per year. It is on the east side, to which the present depressions are chiefly confined, that the greatest depths of ocean lie and the most violent earthquakes originate.

Prof. Omori also compares the variations in the average height of the sea-level in the whole of Japan (the barometric and temperature corrections being made) with the variations in the latitude of Tokyo and Mizusawa for each year from 1895 to 1910. The curves representing both variations show a remarkable correspondence. The average height of the sea-level was greatest in 1899 and 1905–06, and least in 1897 and 1902; the latitude was a maximum about 1899–1900 and in 1906, and a minimum in 1897 and 1902. Corresponding to a variation of 0·1″ in the latitude, there was a change of 40 mm. in the height of the sea-level.

The examination of the records at seventeen mareograph stations in Italy and Austria from 1900–08 shows that in all parts of Italy the height of the sea-level was decreasing by amounts ranging from 10·5 mm. per year in the neighbourhood of Pola and Ancona, to between 4 and 5 mm. per year at Naples and Messina and less than 2 mm. per year at Palermo. In 1908 the mean sea-level reached a well-defined minimum, and Prof. Omori suggests that this may have been a secondary cause of the Messina earthquake at the close of that year.

C. D.

[1] F. Omori: (1) "On the Recent Sea-level Variation at the Different Japanese Mareograph Stations" (Bull. Imp. Earthq. Inv. Com., vol. v., 1913, pp. 39–86). (2) "Note on the Recent Sea-level Variation at the Italian and Austrian Mareograph Stations, and on the Cause of the Messina-Reggio Earthquake of 1908" (*ibid.*, pp. 87–100).

NOTES.

A STATUE of Lord Kelvin, which has been subscribed for mainly by the public of Belfast, is to be unveiled to-day (Thursday) in the Botanic Gardens, Belfast. The Chancellor of the Queen's University, Belfast (the Earl of Shaftesbury, K.P.), will preside, and Sir Joseph Larmor, M.P., F.R.S., will perform the unveiling ceremony, and deliver an address. The statue is the work of Mr. Bruce Joy. Invitations to the ceremony have been issued to the Lord Mayor and Corporation of Belfast, to the Senate and professors of the Queen's University, Belfast, and to a number of leading men of science.—The statue of Lord Kelvin erected by the contributions of his fellow-citizens in Glasgow and the west of Scotland has been placed in position by the side of the new Kelvin Avenue, which traverses the Kelvingrove Park beneath Gilmorehill, close to the University of Glasgow. The statue will be unveiled on October 8 next, by the Right Hon. A. Birrell, Lord Rector of the University, and an address on Kelvin will be subsequently delivered by the Right Hon. A. J. Balfour, Gifford lecturer in the University. —The Kelvin memorial window in Westminster Abbey will be unveiled on July 15.

IT is with deep regret that we have to announce the death, from spleno-medullary leucæmia, of Prof. N. H. Alcock, Joseph Morley Drake professor of physiology in McGill University, Montreal. Prof. Alcock was born in 1871, and received his medical education at Trinity College, Dublin, and Sir Patrick Dun's Hospital. He graduated as B.A. and M.D. in Dublin University in 1896, taking senior moderatorship and gold medal in natural science. He was shortly afterwards appointed demonstrator of anatomy at Victoria University, Manchester. In the following year he was appointed assistant professor of physiology in Dublin University. In 1903 he became demonstrator of physiology at London University, and in the following year he succeeded Dr. Waller as lecturer in physiology in St. Mary's Hospital Medical School, Paddington. In 1909 he obtained the degree of D.Sc. of London University in consideration of his researches on the influence of anæsthetics on nervous phenomena. In 1911 he was appointed to the chair of physiology at McGill University, Montreal. By his early death British science has lost a valuable worker. His experimental work was always most scrupulously verified by every possible control, and he took extraordinary care to reduce experimental error to a minimum. Among his numerous scientific publications were papers concerning "Irish Bats," "The E.M.F. of the Negative Variation of Various Nerves, especially the Vagus," "The Velocity of the Nervous Impulse in Tall and Short Individuals," "The Relations between the Physical, Chemical, and Electrical Properties of the Nerves," "A Text-book of Experimental Physiology" (conjointly with Dr. F. O'B. Ellison), "Accurate Dosage of Chloroform by Means of a Regulating Inhaler," and many others. Prof. Alcock married, in 1905, Norah Lilian Lepard, daughter of Sir John Scott, K.C.M.G., and leaves his widow, one son, and three daughters to mourn his loss.

MR. A. R. HINKS, F.R.S., chief assistant at the Cambridge Observatory, and University lecturer in surveying and cartography, has been appointed assistant secretary of the Royal Geographical Society.

THE new wing of the laboratories of the Rothamsted Experiment Station, Harpenden, will be opened by the Right Hon. W. Runciman, President of the Board of Agriculture, on Friday, June 27, at 3.30 p.m.

THE death is announced, in his sixty-fifth year, of Mr. F. A. Ober, one of the best known of American ornithologists. In the interests of his favourite pursuit he had travelled extensively in South America, Mexico, and the West Indies. In the Lesser Antilles, in particular, he discovered twenty-two new species of birds, and added many types to the collections of the Smithsonian Institution. Mr. Ober wrote largely for the newspaper press, and was the author of forty books.

ON June 5 the faculty of science of the University of Geneva erected a bust to the memory of Pierre Prevost (1751–1839), the Geneva man of science whose name is remembered by Prevost's theory of exchanges. Prof. C. E. Guye presided at the ceremony, and most of the learned societies with which Prevost was associated sent delegates, or addresses of congratulation. M. G. Lippmann represented the Paris Academy of Sciences, and delivered an oration. The Royal Society and the Royal Society of Edinburgh were represented by Dr. W. H. Young, F.R.S., and Mr. Mitchell respectively, who presented addresses in English. The Berlin Royal Academy of Sciences sent a letter of congratulation signed by Prof. Planck.

A TIDAL observatory has recently been constructed by the Ordnance Survey at the foot of the Castle Rock at Dunbar, and is now fitted with a self-recording gauge and other instruments. The main object is to obtain an accurate value for a mean sea-level datum on the open North Sea coast to which the network of geodetic levelling in Great Britain can be very precisely connected. Such an accurate determination is required for the measurement of relative movements of land and sea along our coasts, an object recommended some years ago by the Tidal Commission on Coast Erosion. Incidentally light may be thrown upon slow vertical movements of the earth's crust, periodic coastal movements due to tidal load, and upon the tidal phenomena of the North Sea generally, with their relations to hydrological and meteorological changes taking place in and over the neighbouring oceans. In this country the existing tide-gauges fulfil comparatively rough requirements in harbours not truly representative of open ocean conditions, and there can be no doubt of the importance for scientific purposes of having well-placed observatories on open coasts and capable of being rigorously connected with the network of geodetic levelling.

The Cape Times of May 7 contains an interesting article strongly advocating the founding of a national botanic garden at the Cape. Matters have already gone some distance in this direction, and the Kirstenbosch estate, which is Government property, has been mentioned as an appropriate site. In the interest of South Africa, no less than of scientific botany, it is sincerely to be hoped that this project may be successfully carried through. A view which has been put forward by certain influential people in South Africa is that the garden should be placed under the control of the Agricultural Department rather than that it should be more directly attached to the South African College, and through it to the scientific botanical staff. This view, however, is one which demands, and doubtless will receive, very careful consideration. A botanic garden which is not under scientific direction can have very little value, and it is to be hoped that, in the interests of South Africa generally, this principle will not be lost sight of in determining the nature of the body which is to be responsible for its proper administration. The problems to be solved are mainly scientific, but from their successful solution there may be expected to accrue results of value not only to science but also of great economic importance to the community at large.

A LARGE number of distinguished physiologists, biologists, and medical men have signed a letter addressed to the Home Secretary directing attention to the scientific aspects of the administration of the Mental Deficiency Bill. The signatories desire to secure the continuous prosecution of research into the conditions on which mental deficiency depends, and into the means by which it might be remedied or prevented. They point out that it may be said, in a general way, that the conditions in question must be due either to defective formation and development of the active structures of some portion or portions of the brain, or to defective formation or supply of the fluids by which these structures are surrounded, and by which they are stimulated to activity. For example, one common form of idiocy is consequent upon the absence from the blood of the secretion which should be furnished by the thyroid gland, and may be remedied by the administration of thyroid extract derived from lower animals. The Mental Deficiency Bill will probably bring together many of its subjects into institutions controlled by the State, and supported by the public. It is therefore urged that the facilities for scientific study which such institutions would afford should be fully utilised for the general benefit of the community, and that the duty of so utilising them should be committed to men of science, fully conversant with all that is already known in relation to the subject, and able to point out the directions in which further inquiry should be pursued. It is suggested that the objects in view could scarcely be obtained except by an adequate representation of biological science upon any Commission to which the administration of the law may be entrusted.

In an interesting paper published in the *Biologische Centralblatt* (vol. xxxiii., No. 3), under the title "The Occurrence of Dextro-rotatory Albumins in Organic Nature," Dr. John Beard has developed the idea, published in 1907, that the albumins of cancer and of malignant tumours in general must be dextro-bodies because of the destructive action, ending in liquefaction, of active pancreatic ferments, especially trypsin, upon them. He now shows that asexual generations of animals such as Hydra, Cordylophora, Trichodina, Vorticella, Carchesium, Amœba, Actinosphærium, and Stentor are rapidly killed and digested by pancreatic ferments (trypsin and amylopsin), and hence concludes that such asexual forms are built up of dextro-proteins; on the other hand, sexual generations such as Daphnia, Nauplii, Planaria, Nais, and Melicerta are not in the least affected by these enzymes, and are therefore probably built up of lævo-albumins. In a striking generalisation, Dr. Beard contends that "the micro-organisms, bacilli, &c., of disease are of necessity composed of compounds which are stereochemical antitheses of those making up the normal human body, and that when compared similarly with the pancreatic ferments, the like is true of the ferments by means of which they effect their ends. Only by means of such antithetic or opposite characters of compounds and of ferments produced by them could such disease-inducing organisms bring about their ravages." The natural method of treatment is therefore to employ against them the ferments produced by the organisms, such as mankind, which are their victims, and of these by far the most potent are the pancreatic enzymes, trypsin and amylopsin.

The transference of the Northern Territory of Australia from South Australia to the Commonwealth has been followed by the more active investigation of the country and its resources. Fresh effort is recognised as necessary, for the total population, exclusive of aborigines, has fallen from 4788 in 1891 to 3005 in 1910. An expedition, consisting of Prof. Spencer, Prof. Gilruth (who has since been appointed Administrator of the territory), Prof. Woolnough, and Dr. Breinl (director of the Australian Institute of Tropical Medicine), visited the country in 1911, and their preliminary reports have been published as Nos. 1 and 1*a* of the Bulletin of the Northern Territory. Prof. Woolnough reports that he was much impressed with the mineral wealth of the country, but as the deepest mine is under 400 ft. in depth he recommends that a shaft should be sunk further in order to determine the extension of the deposits in depth. Prof. Gilruth reports on the domestic animals in the territory, and discusses the source of the two prevalent cattle diseases, red water or tick fever, and worm nodules. He concludes that they were introduced from Java in 1872. The red-water fever has spread from the Northern Territory to Queensland. He concludes that under the conditions that have hitherto prevailed the satisfactory development of the country could not be expected, but with a better system of administration and more reasonable land tenure the country possesses unlimited possibilities. Dr. Breinl describes the diseases prevalent amongst both the Europeans and aborigines. He gives full tables of the health statistics available. Malaria is widely spread, and was probably introduced from New Guinea; it is distributed by a mosquito, *Nyssorhynchus annulipes*. Dr. Breinl believes that malaria could be controlled by proper methods. He finds that the white people living under active conditions have good health, and the hæmoglobin content of the blood in children is normal. The population is, however, too small for its evidence to show whether the country can be developed by white labour.

The Museum Journal, of Philadelphia, in its last issue, records the purchase from members of the punitive expedition to Benin of a fine series of brasses and ivory carvings. Of the former class the more important specimens are two bronze heads, said to be portraits, with remarkable head-dresses and a high neck ornament, in one case rising as high as the lower lip. On heads like these the carved ivory tusks, which were apparently objects of veneration, are said to have been placed. A large bronze plaque represents a high official, wearing the same type of necklet, and standing surrounded by his attendants and slaves. Another fine exhibit is a pair of bronze cocks, about life-size, with chiselled feathers and the eyes inlaid with iron.

We have to acknowledge the receipt of No. vi. of Dr. Koningsberger's "Java," which is chiefly devoted to the fauna of the Bouwland.

To the author, Mr. H. Schmidt-Jensen, we are indebted for a copy of a paper, from *Vidensk. Meddel. fra Dansk. naturh. Foren*, vol. lxv., on regeneration in the antennæ in larvæ of a phasmid insect, *Carausius* (*Dixippus*) *morosus*, as the result of both natural and artificial injuries.

No. 2 of the tenth volume of the University of Colorado Studies is devoted to an illustrated synopsis, by Messrs. M. M. Ellis and J. Henderson, of the amphibians and reptiles of Colorado. Despite the varied physical conditions of the country, which in several other groups of animals is correlated with a large and diversified fauna, the species of the groups under review are not remarkably numerous. No new species are recorded.

The existence of a close relationship between the faunas of India and Africa, which was so strongly urged by the late Dr. W. T. Blanford and subsequently by Mr. Lydekker, is emphasised in an article by Mr. Ernst Schwarz on Indian Viverridæ, published in vol. lxxviii., part 11, of *Archiv für Naturgeschichte*.

It is there pointed out that the true civets (Viverra) have closely allied representatives in the two continents, and that the same holds good for several groups of mongooses (Mungos or Herpestes), while the Indo-Malay linsangs (Prionodon) are near relatives of the African Poiana. It is also pointed out in this paper, and in a second by the same author (*op. cit.*, part 12) on the extinct viverroid genera Palhyæna and Ictitherium, that although the Viverridæ are the most primitive type of cat-like Carnivora, and have some representatives (Poiana and Prionodon) approximating to the feline type, while the above-mentioned extinct genera show an equally marked step in the direction of the Hyænidæ, yet that in both instances these resemblances should be regarded in the light rather of convergence than of direct ancestry, the Felidæ having in all probability originated independently from a still earlier stock.

A recent number of *Science* (May 2) contains an account by Dr. C. Gordon Hewitt, entomologist to the Dominion of Canada, of the Imperial Bureau of Entomology. This organisation has grown out of the Entomological Research Committee appointed in 1909 by Lord Crewe, then Secretary of State for the Colonies. The functions of the bureau, which is supplementary to the existing research committee, are to collect and coordinate information relating to the noxious insects of the world, to undertake the authoritative identification of insects of economic importance submitted by the Departments of Agriculture and Public Health throughout the Empire, and to publish a monthly journal giving summaries of all current literature which has a practical bearing on the investigation and control of noxious insects. Mr. Guy A. K. Marshall, the scientific secretary of the research committee, has been constituted director of the bureau and editor of the journal, the first issue of which, under the name of *The Review of Applied Entomology*, appeared in January of this year. It is being published in two parts, devoted respectively to agricultural and to medical and veterinary entomology. Dr. Gordon Hewitt points out that there are no fewer than 1700 periodicals which may contain articles dealing with the subjects of which the bureau takes cognisance, and that entomologists in many remote districts have neither the opportunity of seeing nor the time to consult more than a small proportion of this literature. Hence the establishment of a central organisation for the collection and dissemination of important economic data is likely to be of the highest practical value.

The results of a comprehensive series of trials with varieties of oats are published as Report 29 of the Edinburgh and East of Scotland Agricultural College. The observations extend over the years 1909–12, and indicate marked differences between the varieties, according to weather conditions, altitude, and character of the soil. Of the twenty-six varieties grown at fifty-two centres, eight surpassed the standard potato oat by from 20 to almost 40 per cent. in yield of grain; five others were from 15 to 16 per cent. better, but none of these improved varieties showed itself equal to the standard oat in respect of straw production. On account of early ripening certain varieties are specially suited to late districts, while others failed to ripen at all at the higher centres in the wet season of 1912.

The Bulletin of the Department of Agriculture of Jamaica (vol. ii., No. 6) contains a number of articles on the fungoid diseases of the banana. Amongst these is an account of the Surinam Panama disease (*Leptospora musae*) of the Gros Michel banana. Investigation has shown the fungus to be a parasite on several varieties of Musa, although the plantain is immune against it. Soil disinfection experiments with carbolineum, copper sulphate, and gas water have been made with negative results. Greater success is anticipated from flooding the infected areas, since the fungus is adversely affected by humid conditions. The introduction of immune varieties, such as the Congo and other bananas, is recommended.

The Meteorological Charts of the North Atlantic Ocean for May and June, issued by the U.S. Weather Bureau, contain interesting articles by Mr. R. E. Harris, illustrated by synoptic weather charts and barograms, relating to the unusually heavy storms in that ocean during January last (possibly the stormiest month on record there), and supported by extracts from log-books of a considerable number of vessels. The most severe storm was that of January 7 to 11 inclusive. This depression had two centres at Greenwich noon, January 8, one over New York, while a storm was central near latitude 49° N., longitude 25° W., and was causing winds of force 8 to 12 (Beaufort scale) between the fifteenth and forty-fifth meridians. By noon of January 9 a rapid development in the western storm had occurred, and it was central near latitude 45° N., longitude 48° W. During the night of January 9–10 some remarkably low barometer readings were recorded, the lowest, 26·96 in., being registered by an aneroid at 52° N., 25° 30′ W. This (if really correct) is probably the lowest reading ever made on the North Atlantic. By noon of January 10 the storm was central near 51° 30′ N., 27° W., the lowest barometer being 27·76 in. The log of the ss. *Cedric* showed a continuous rise of 2·8 in. in twenty-five hours and forty minutes (from 27·49 in. to 30·29 in.), which, Mr. Harris observes, probably marks a record north of the thirty-fifth parallel.

Mr. G. H. Knibbs, of the Australian Bureau of Census and Statistics, recently contributed a paper to the *Philosophical Magazine* on climatological physiology. His view is that in "the mechanical and chemico-physical arrangements of the human thermostat actions supervene after about 30° C. is reached which disturb those conditions of thermogenesis and thermolysis which are necessary for the thermostasis of the organism." He analyses a number of experimental results obtained by Prof. W. A. Osborn for losses from the human body by evaporation, and discusses them from the theoretical side. The problem in its simplest form is the same as the problem of the wet-bulb thermometer, and Mr. Knibbs uses the results of Regnault, Stefan, Marvin, and others on the relation of evaporation to temperature, relative humidity, and wind in his discussion. He finds that the change in the loss by evaporation under different conditions is proportional to the product of the absolute temperature and the absolute dryness or saturation deficit, and he makes the interesting suggestion that sufficient observational results should be obtained to give normal values for the constants for different sexes, races, &c. Incidentally the paper emphasises the importance of the wet-bulb temperatures as a climatic factor, especially in tropical or semi-tropical regions. It may be noted that experiments on the effect of different meteorological conditions on the human body are being conducted by Dr. J. R. Milne at Edinburgh, a preliminary account being given in the recently issued Journal of the Scottish Meteorological Society.

The Meteorological Institute of the Netherlands has issued copies of thirteen of the principal magnetic disturbances of the year 1911, as recorded at de Bilt, and the director of the institute, Prof. van Everdingen, intimates that in future it is intended to publish each year copies of the chief disturbances, as indicated on the international lists compiled under his auspices. The time scale adopted is 15 mm. to the hour, and the curves—declination, horizontal force, and vertical force—are very clearly reproduced.

We have received a copy of an address delivered by Dr. Wolfgang Ostwald before the eighty-fourth Versammlung Deutscher Naturforscher on "Die neuere Entwicklung der Kolloidchemie" (pp. 23, T. Steinkopf, Dresden, price 1 mark). Colloid-chemistry is a branch of science which has made striking progress during the past few years, and has now not only a distinct terminology of its own, but a journal, the *Kolloid-Zeitschrift,* to chronicle its advances. The brief review given by Dr. Ostwald of recent development of the science should prove of interest to many workers in the numerous fields of science and industry in which a knowledge of colloids is of importance.

We have received a copy of the *Compte Rendu* of the Geneva Physical and Natural History Society for the year 1912. The society has sixty-eight ordinary and forty-two honorary members, and admits twenty-eight associates free. The *Compte Rendu* extends to more than eighty pages, and contains articles on physics, chemistry, botany, geology, and zoology of considerable interest. Amongst the most important of these articles are Prof. Guye's on the internal friction of metals at high and at low temperatures, and M. Tommasina's surveys of Ritz's theories of the æther and of gravitation.

The June number of *Terrestrial Magnetism and Atmospheric Electricity* contains a list of the determinations of declination made on the magnetic survey ship *Carnegie* during its voyage across the Pacific from Tahiti, Society Islands, to Chile, and thence *viâ* Cape Horn to the Falkland Islands. Comparisons are made between the values obtained and those given on the United States, the German, and the British charts. So far as the latter is concerned, the corrections to be applied to the charted values are in most cases less than one degree, but exceed that amount at nine points off the coast of Chile and Patagonia, where the chart shows the easterly declination too small.

In a paper recently published in the Bulletin of the Imperial Academy of Sciences of St. Petersburg, Prof. P. Walden brings forward additional evidence in favour of the view that the degree of dissociation of a given solute is independent of the nature of the solvent if each solution is at the saturation point. This was demonstrated previously for tetramethylammonium iodide, $N(C_2H_5)_4I$, in fourteen solvents, but is now shown to be true for tetramethylammonium iodide, $N(CH_3)_4I$, in ten solvents ($\alpha = 0{\cdot}666$), for tetrapropylammonium iodide, $N(C_3H_7)_4I$, in five solvents ($\alpha = 0{\cdot}26$), and, finally, for potassium iodide, KI, in three solvents ($\alpha = 0{\cdot}423$).

In the May issue of the Chemical Society's Journal Dr. Scott describes some new methods for the preparation of pure bromine. The first method depends on getting rid of iodate and iodide by boiling potassium bromide with a little potassium metabisulphite and sulphuric acid, then twice adding saturated bromine water and distilling off the bromine, and finally neutralising with potassium carbonate and evaporating to dryness. The bromide was then fused with potassium dichromate in quantity insufficient to decompose any chloride that might be present; the fused mass was decomposed by sulphuric acid with the addition of a little permanganate to decompose organic matter. A quantity of 3250 grams of pure bromine was prepared in this way, together with an additional 185 grams, which should contain all the chlorine, but this was found to amount only to 4 or 5 milligrams. The halogen impurities were separated by extracting the bromine with caustic soda; this appears to provide a very simple and a most effective way of purifying bromine, the chlorine being removed as chloride, and the iodine as iodate. By this method the whole of these halogens can be removed from 10 c.c. of bromine by extracting once with 5 c.c. of normal sodium hydroxide.

OUR ASTRONOMICAL COLUMN.

Observatories and Cities.—Modern astronomical research work, which necessitates the long exposure of photographic plates and the observation of faint stars, is gradually separating old observatories from their historic surroundings and creating new buildings in more favourable situations. The Hamburg Observatory is now settled in its new site in Bergedorf, some distance away from the city, and the new ground is bristling with domes of the latest construction. Berlin Observatory is now on the move, taking up its new position in Neu Babelsberg, not very far from its astrophysical *confrère* at Potsdam. At the present time the question is being considered as to the removal or part removal of the Paris Observatory, as the conditions on the site now occupied are not conducive to the best observational work. Those unfamiliar with the present locality can obtain a good idea of it in relation to Paris from the excellent reproduction of a photograph by M. Baillaud which is given in the current number of *The Observatory* (June, No. 462).

Neptune's Faint Equatorial Belts.—Dr. T. J. J. See publishes in the *Astronomische Nachrichten*, No. 4656, a paper describing some observations he made on the planet Neptune in 1899 and 1900, with the 26-in. refractor of the Naval Observatory at Washington. On some days in those years the air was particularly steady and the mottled appearance of the disc of the planet accidentally attracted his attention. This led him more closely to scrutinise the disc, and he noticed that beaded bands or belts were faintly visible against the brighter body of the planet. The seeing on these occasions was such that 95 Ceti, the most difficult of known double stars, was resolved, and other difficult pairs, such as 85 Pegasi and T Cygni, measured. The bands, he says, were found to be extremely faint, but on a few occasions they came out with more distinctness, and he attaches drawings from which their general character can be inferred. Dr. See refers to Prof. Asaph Hall's observations with the same instrument, which gave the suggestion of suspected mottlings on the planet's surface, and to Prof. S. J. Brown, who noticed an unsymmetrical appearance on the disc. As Dr. See points out, the chief interest attaching to the discovery of these equatorial belts arises from the circumstance that phenomena depending on planetary rotation first noticed on Jupiter, and then on Saturn, and finally on Uranus, are now seen to be common to the most remote member of the solar system. The paper concludes with a brief notice of the discovery of belts on the other major planets.

Variable Stars.—Numerous recent papers deal with the subject of variable stars. Prof. A. A. Nijland, of Utrecht, sends a pamphlet on the light curves of twenty-three Algol stars, and the classification of variables. Two papers in the *Astronomische Nachrichten* (No. 4653, vol. cxciv.) deal respectively with the ellipsoidal variables Sl Tauri and S Antliæ, by Harlow Shapley, and the variability of the pole star by Ant. Pannekoek.

Photometric observations of variables is the subject of Padova's communication to the *Mem. della Soc. dei Spettroscopisti Italiani* (April, disp 4*a*, vol. ii., ser. 2*a*), and he deals with two Algol variables, U Ophiuchi and RZ Cassiopeiæ; two variables of short period, Y Ophiuchi and β Lyræ; five long-period variables, and two irregular variables, RS Cygni and R Scuti. Light curves accompany the observations in most cases. Harlow Shapley contributes a paper on the visual and photographic ranges and the provisional orbits of Y Piscium and RR Draconis to the April number of *The Astrophysical Journal*, while the same journal also contains a second paper by Frederick H. Seares on the Algol variable RR Draconis. Prof. E. C. Pickering refers in Circular 177 of the Harvard College Observatory to the maximum brightness of Algol variables.

Kodaikanal Solar Prominences during 1912.—Bulletins Nos. 29 and 30 of the Kodaikanal Observatory contain a summary of prominence observations made at that observatory during the past year. Previously it was customary to publish detailed lists of prominences, such as those which appeared in the series of bulletins ending with No. 28, but these will now be discontinued and replaced by a *résumé* of the observations issued half-yearly. This *résumé* will include full descriptions of any remarkable phenomena observed or photographed, and, in addition to the summary of the observations at the sun's limb, there will be given the results of a study of the prominences projected on the disc as hydrogen absorption markings. The present two bulletins are written on these lines, and they contain the summarised material for 1912.

THE ALLOTROPY OF IRON.

TWO papers read before the recent meeting of the Iron and Steel Institute, one by Dr. Carpenter on the critical ranges of pure iron, and the other by Dr. Rosenhain and Mr. Humfrey on the tenacity, deformation, and fracture of soft steel at high temperatures, were responsible for a renewal of the discussion upon the allotropic modifications of iron. The present discussion may be regarded as a further contribution to an old controversy, and in order to appreciate its true significance it is necessary to review, somewhat in the manner of a serial story, the incidents of the preceding chapters.

In 1890 Osmond showed that when a piece of steel was allowed to cool from a bright red heat the rate of cooling was not uniform, but that at three points there was an evolution of heat in the steel itself which had the effect of retarding the fall in temperature of the mass. These three arrests Osmond designated as A1, A2, and A3, A1 representing the change taking place at the lowest temperature. In order to distinguish between the evolutions of heat during cooling and the corresponding absorptions of heat during heating, the letters *r* (*refroidissement*) and *c* (*chauffage*) were added, and this nomenclature has been retained, the irregularities in the cooling curve being described as Ar1, Ar2, and Ar3, and those in the heating curve Ac1, Ac2, and Ac3.

It was clearly shown by Osmond that the A1 change was dependent upon the carbon in the steel, whereas the points A2 and A3 were independent of the carbon and equally prominent in the purest steel obtainable. Osmond therefore argued that the thermal changes at A2 and A3 must be due to molecular rearrangement or allotropy in the iron. Iron above the A3 point he described as γ iron, that between the A3 and A2 points β iron, and below the A2 point α iron.

Roberts Austen repeated and confirmed Osmond's experimental work, and accepted his theory of allotropy as being the most probable explanation of the facts. Prof. Arnold, on the other hand, rejected the allotropic theory on the ground that "steel research was, in his opinion, a field of too national an importance to be used lightly as a cantering ground for the hobbies of periodicity and allotropy." After repeating and confirming the work of Osmond and Roberts Austen, Prof. Arnold suggested that the A3 point was due to the influence of hydrogen, and the A2 point to a change from a plastic to a crystalline condition. He contended that these changes had little connection with the phenomena underlying the hardening of steel, but that these were due solely to the carbon, and at a later date he developed a subcarbide theory to explain the changes brought about by hardening, &c. Further investigations, however, by independent metallurgists, tended to confirm Osmond's original views, and within the last few years little has been heard of the controversy between the "carbonists" and the "allotropists."

The two papers which have been responsible for the reopening of the discussion may be briefly summarised as follows:—Prof. Carpenter, following a hypothesis of Benedicks, endeavours to prove that the change at Ar2 is not an independent change, but merely the tail end, or limit of supercooling due to impurities, of Ar3. It may be mentioned that this was Osmond's original explanation, which he abandoned when it was proved that the appearance of magnetism coincided exactly with the point Ar2. Prof. Carpenter argues that if Benedicks's theory is correct pure iron should show the Ar2 change but not the Ac2 change, and he gives a number of heating and cooling curves of the purest iron obtainable in support of his view. Unfortunately, as Prof. Arnold has pointed out, the heating curves actually show the Ac2 change. It is true that they are less strongly marked than the Ar2 changes, but this is only what would be expected.

The changes during heating, as shown by inverse rate curves, extend over a greater range and are therefore less strongly marked than in the cooling curves. This is well shown in the A3 change shown in the curves, and in view of the fact that the Ar2 change is itself very small, it was scarcely to be expected that the Ac2 change would be very easily detected. Moreover, Prof. Carpenter has shown that if the iron, after cooling just below Ar3, is held at that temperature for two and a half hours in order to allow the change from γ to α iron to become complete, and then slowly cooled, the Ar2 change is shown as decidedly as before. He attempts to explain this by assuming that the impurities present are sufficient to prevent actual contact of the γ and α molecules, but the explanation is unsatisfactory, and his results must be regarded rather as proving than disproving the independence of the A2 critical point.

The paper by Dr. Rosenhain and Mr. Humfrey describes a series of experiments admirably conducted with the aid of an ingeniously constructed testing machine, in order to investigate the physical properties of mild steel at high temperatures. It is impossible to describe the experiments in detail, but the results show that the curve representing the tenacity at high temperatures consists of three branches corresponding to the γ, β, and α ranges of iron. Starting at 1100° C., the tenacity increases as the temperature falls, until the Ar3 point is reached, when there is a rapid decrease in tenacity. This is followed by a further increase until Ar2 is reached, when there is another falling off in tenacity. The influence of the rate of strain is discussed, also the influence of varying size of crystals; and photographs are given to illustrate the types of fracture at different temperatures. The authors conclude that they find it difficult to reconcile their results with Benedicks's theory by which β iron is regarded as a solution of γ iron and α iron.

Prof. Arnold's contribution to the discussion when separated from side issues resolves itself into little more than a reassertion of his own theories, which he claims are supported by the two papers in question. The one useful criticism which Prof. Arnold makes has already been referred to, in which he points out that the Ac2 change is observable in Prof. Carpenter's curves.

The criticism of Dr. Rosenhain and Mr. Humfrey's paper is even less helpful. It is claimed that the authors' conclusions are of no value owing to their "erroneously presupposing that they are discussing results obtained from chemically pure iron rather than from their dead mild commercial steel." It is possible that the authors have underestimated the importance of the impurities in their steel and have pushed their conclusions a little too far, but they give full details of the material upon which their experiments have been carried out, and they make no claim that their conclusions are final. Nevertheless, the authors have laid themselves open to some criticism inasmuch as they have chosen for their experiments a steel which, even from a commercial point of view, is of very poor quality.

As a matter of fact, the importance of the discussion has been exaggerated, and the two papers leave the β iron theory very much where it was before. The somewhat ill-defined A2 change and its relation to the physical properties of steel will still attract the attention of men of science who are anxious to discover the truth. Other papers will be read and further discussions will take place, but in the meantime, and until further evidence is forthcoming, those who are wise will refrain from a too dogmatic insistence upon their own particular views.

THE ROYAL SOCIETY CONVERSAZIONE.

THE annual June conversazione of the Royal Society was held in the rooms of the society at Burlington House on June 11. As is usual upon such an occasion, various instruments and objects of scientific interest were exhibited. Most of these have been described already in the account of the May conversazione given in NATURE of May 15 (p. 273). Other exhibits are mentioned below:—

Dr. E. C. Pickering: Colour-blindness, if any, of eminent astronomers. The sensitiveness of the eye to rays of different colours has been tested for numerous astronomers by grouping their estimates of the light of the stars according to their colour, as shown by the class of spectrum. The earliest estimates, those of Ptolemy and Sûfi, show results agreeing closely with those of recent times. Peirce shows a marked sensitiveness to the red, and Seidel to the blue, rays. The latter effect is still more marked in photographic plates.

Prof. Silvanus P. Thompson: Poulsen's telegraphon. The telegraphon of Dr. V. Poulsen, of Copenhagen, is an apparatus which records speech or sound transmitted by telephone, and reproduces it, at any subsequent time, in another telephone. The recording is effected magnetically. In this newest pattern, a thin wire of tungsten steel is caused to run rapidly between the poles of a small electromagnet in the receiving circuit of the telephone; and this electromagnet impresses the corresponding vibrations on the wire by magnetising it in an immense series of minute local spots. The record on the wire is absolutely invisible. On passing the wire again between the poles of a small electromagnet in the circuit of a receiving telephone, the series of minute magnetic spots on the wire sets up, by magneto-electric induction, a corresponding series of electric undulations, causing the telephone to emit a corresponding sound. The sounds so reproduced are faint unless a Brown telephone relay is employed to magnify them.

Mr. R. Inwards: Spiraloid curve apparatus. This is an instrument consisting of a revolving table carrying the paper, and over which a pen is caused by gear-wheels and adjustable cranks to describe an undulating line, and to produce figures resembling the structure of the Diatomaceæ, Radiolaria, and other natural forms.

Mr. C. R. Darling: Experiments with liquid drops and skins. (1) Large drops of liquids may be formed in media of slightly less density, *e.g.* orthotoluidine in water at 18° C. The formation is gradual, and all the stages may be observed by the unaided eye. If two drops of different diameters be made to communicate through a tube, the lesser passes into the greater when both are at the same level; if, however, the lesser drop be lowered, the movement is reversed. A position of equilibrium may be found in which both drops are stationary. (2) Skins of aniline may be formed on suitable frames under water, and made into bubbles filled with water. (3) Skins of various liquids on the surface of water exhibit characteristic movements, depending upon the liquid used.

Dr. T. K. Rose: Recrystallisation of gold on annealing. The specimens exhibited of incompletely annealed gold show that the new crystals make their appearance singly when annealing begins, and that as the temperature is raised or the time prolonged, other crystals are produced round those first formed. Some of the original crystals, which have been distorted by rolling, are completely broken up into the new smaller crystals before recrystallisation begins in other laminæ. The new crystals are soft, and the unaltered laminæ remain hard. Incompletely annealed metal thus consists of alternate strips of hard and soft material.

Prof. C. J. Patten: (1) Model illustrating the topography of the Tuskar Rock and Lighthouse relative to some features in the diurnal migration of certain birds. (2) Studies in the migratory movements of birds at the Tuskar Light-station, illustrated by a series of photographs.

The John Innes Horticultural Institution: Phenomena of plant-breeding. (1) "Maternal" hybrids and actual hybrids in Primula and Nicotiana. (2) Inheritance of double flowers and sex in Tropæolum. (3) Inheritance in *Campanula persicifolia*. (4) Double flowers of various types in Begonia.

Dr. G. D. H. Carpenter: A synepigonic series of *Papilio dardanus* from the parent form *planemoides*. This exhibit represented the first proof by breeding that the form *planemoides* is definitely of the species *Papilio dardanus*.

Dr. H. F. Standing: Photographs of the skeletons of extinct giant lemurs from Madagascar, also casts of skulls of the same. This exhibit showed casts of the skulls and photographs of the mounted skeletons of two species of giant lemur recently exhumed in a subfossil condition at Ampàsambazimba, in the centre of the Island of Madagascar. The smaller animal (*Palaeopropithecus maximus*) shows curious specialisation for an amphibious mode of life. It probably burrowed in the banks of lakes and streams; the peculiar roughened upward extension of the nasal bones no doubt carried some kind of epidermal excrescence, presumably used in burrowing. The larger animal (*Megaladapis grandidieri*) was arboreal in its habits, and its mode of life probably resembled that of the chimpanzee.

Prof. W. M. Flinders Petrie: Egyptian jewellery, 3400 B.C. The pectoral exhibited is of soldered gold inlaid with cut turquoise, lazuli, and carnelian, like the celebrated pectorals of Dahshur, and probably by the same artist. Found with it was a piece of inlaid open work of Senusert II., and a gold shell with soldered wire work of Senusert III. None of this fabric has reached England before. These were found at Gerzeh, forty miles south of Cairo, in a grave in which a plunderer had been killed by a fall of the roof.

REMARKABLE DROUGHT IN THE PHILIPPINES.

THE drought experienced during the eight months, October, 1911–May, 1912, probably the most severe ever observed in the archipelago, has been discussed by the assistant director of the Weather Bureau. At Manila the total rainfall recorded during the period was only 3·73 in., or a monthly average of less than half-an-inch; the driest month was April, with only 0·03 in. The following rainless periods are especially noteworthy: October 24–November 16 (24 days); November 20–December 11 (22 days); March 19–April 12 (25 days); April 14–May 7 (24 days). Deducting the insignificant amount of 0·004 in. (0·1 mm.) on May 8, there would result a rainless period from April 14–May 20 (37 days).

Sr. Coronas shows that, so far as Manila is concerned, the drought was the worst experienced since the establishment of the observatory in 1865. From a cursory inspection of his tables it is seen that for the months October–December, 1911, the rainfall was 14·05 in. below the normal; for the months January–May, 1912, 5·10 in. below, and that the total rainfall for the eight months was 5·56 in. below the absolute minimum recorded for those months during the entire period. In other regions of the archipelago the results cannot be so convincing as those for Manila, as the statistics for the secondary stations cover only a relatively short period. A table of the rainfall at twenty-six selected stations shows that it was without exception less than the normal at every station. The longest dry periods occurred in western Luzon, and the shortest on the eastern coasts of Samar and Mindanao; this was to be expected, as in the former case the dry season is most pronounced, especially from December to March, and in the latter case during the same months the most persistent rains of the whole year occur. An extraordinary period of 165 days without rain occurred at Vigan (western Luzon) between December and May.

Some very high temperatures were recorded in April and May. At Manila a maximum of 100·9° (38·3° C.) occurred on May 19; so high a temperature had not been recorded since May, 1889. It may not be without interest to recall the fact that the drought of the summer of 1911 in this country was followed by a remarkable period of excessive rainfall during the winter six months of 1911–12. This period has been specially discussed by Dr. Mill, and referred to in our columns.

WORK OF THE ROTHAMSTED EXPERIMENTAL STATION.

THE annual report for 1912 of the Rothamsted Experimental Station, which has lately been issued, includes an introduction, the annual report proper, and a supplement giving the year's yields of the various series of plots. The report deals first with the season 1912, its peculiarities, and their effect on the crops, and proceeds to give short abstracts of the work of the various members of the staff.

The central idea of the work of the Rothamsted Experimental Station is the investigation of the relation between plants and the soil in which they grow. Dr. Russell, who has during the year succeeded Mr. Hall as director, is engaged, in conjunction with Messrs. Hutchinson, Golding, Petherbridge, and Goodey, in investigating the effects of partial sterilisation of the soil. His results have now got beyond the theoretical stage. Partial sterilisation is now practised largely in the glasshouses of the Lea valley with good results, and has so impressed the tomato and cucumber growers of that district that they are endeavouring to get established an institute for the investigation of the problems of glasshouse culture—a most encouraging instance of the readiness of practical men to adopt any really sound innovation put before them in a feasible form.

Dr. Miller continues his investigations of the nitrogen content of rainfall and drainage. Dr. Brenchley is studying the possible stimulating effects of poisons on plant growth, and has extended her survey of the weeds of arable land to the eastern counties. Mr. Davis has published the results of a careful series of comparative determinations of potassium by the perchlorate method, which he recommends as accurate and trustworthy. The method is well worth the attention of analysts in these days of dear platinum.

The report on the whole is of great interest as showing the varied methods of attack which are being applied with success to the central problem of the relation of plants to the soil in which they grow. References are given to the original publications, which are for the most part contained in *The Journal of Agricultural Science.*

The report is accompanied by a circular of the society for extending the Rothamsted experiments, which gives details of the financial position of the trust. Subscriptions are invited for the rebuilding of the old laboratory, which must shortly be undertaken, and for the maintenance of the permanent plots, which entails very considerable annual expenditure.

DESIGN AND USE OF SCIENTIFIC INSTRUMENTS IN AERONAUTICS.[1]

AFTER expressing his admiration for the character of Wilbur Wright, his brilliant engineering work, and the scientific method by which he obtained his results, the lecturer considered the resemblance and differences of the manufactured aëroplane and the living bird. The resemblance may be simply the result of copying the bird, or it may be that similar designs have been arrived at independently by birds and men. The wings of both are roughly the same shape: of wide span, and narrow in the direction in which the bird flies; both have concave wings with thick leading edges. In many aëroplanes hollow spars are used like bones and like the quills of the feathers of birds. We copy plants also in this respect, for they too have learnt the economy of material in the use of hollow spars.

These resemblances are remarkable, but there are great differences. The Wright brothers found no biplane bird to copy and did not flap their wings. No flying animal uses a continuously rotating propeller to drive him forward on soaring wings, and it is perhaps scarcely too much to say that if birds only knew how, they would now copy the Wright brothers. Muscular action and the circulation of the blood, however, put supreme difficulties in the way of the development of the continuous rotation of a part of an animal.

Instruments Used in Aëroplanes.

It is important to realise beforehand the difficulties of using instruments on aëroplanes during flight and the errors that may be introduced in the readings. The aëroplane shakes, it does not remain level, and is subject to acceleration in all directions. The instrument should be so designed as not to be affected by any of these disturbances. A vertical acceleration has the same effect as a change in the amount of the downward pull due to gravity; the tilting of the aëroplane changes the direction of the downward pull with regard to the instrument. A lateral or longitudinal acceleration has the effect of altering both the direction and the amount of gravity. But vibration is a greater difficulty still. The hand of an instrument may move so much and so rapidly that it is difficult to estimate the mean reading on the scale, and sometimes it is quite impossible to do so. And this may happen when the quantity which is indicated by the position of the hand only varies slowly and by small amounts. The moving part of an instrument should be well balanced. This reduces the vibration from the shaking of the aëroplane as well as the error caused by its tilting or want of level.

In a compass as ordinarily made, the condition of balance cannot be fulfilled. The magnet rests on a steel point and is horizontal, and its centre of gravity is below the steel point. The force on the north pole acts in a downward direction towards the north, and the force on the south pole in an upward direction towards the south, and the magnet is made to rest in a horizontal position by arranging that the centre of gravity of the magnet is between its south end and its centre. It is below and to one side of the point about which rotation takes place. Hence a sideways movement must start it swinging. The magnet and card in aëroplane and ship compasses are usually surrounded by a liquid, so that any vibration which may be caused by its want of balance is rapidly reduced.

Instruments on aëroplanes should be damped, using the word to damp in the sense of "to dull" or "to abate the motion of." This damping is specially important if it should happen that the rate of vibration of the whole instrument should agree with the natural rate of vibration of the moving part. When this happens with an undamped instrument, the vibration is excessive. Damping is also required in cases where the fluctuations in the quantity to be measured are rapid; it may then be difficult to read the instrument, and the excursions of the hand may indicate a much greater amount of variation of the quantity than really takes place. If the mean reading is required the instrument must be damped, and the damping should be of a particular kind.

The essential features of satisfactory damping are that no force should be applied to the moving part whilst it is at rest, but that as soon as it moves a force should act opposing the movement. Friction at the joint does damp the instrument, but does not fulfil these conditions, and is bad. The force should be small when the movement is slow, and it should increase when the movement becomes more rapid. The most usual method is to immerse the moving part, or a paddle fixed to it, in a liquid more or less viscous, or the paddle can be replaced by a fan in the air. Another method is to damp by the movement of a copper plate between the poles of a magnet. If a Pitot tube is used, the flow of air through the connecting tubes damps the instrument.

Mr. A. Mallock has pointed out that in order to obtain a true mean reading with an instrument the damping force should be proportional to the velocity of movement of its index. When the damping force varies as the square of the velocity there may be no error or there may be a considerable error. Suppose that the quantity to be measured remains at 80 for 2/10 second, and then suddenly increases to 140 and remains at that amount for 1/10 second, and then it goes back to 80 and remains at that amount for 2/10 second, and that this rapid oscillation goes on indefinitely. Suppose also that the instrument is damped by a force which varies as the square of the velocity of the index, and that it is so much damped that the hand appears to remain at rest. The reading of the instrument will be 92 and the true mean in reality is 100, so that we have an error amounting to 8 per cent., by no means a small error. The diagram (Fig. 1) gives the supposed variations of the quantity as it would be recorded on a moving sheet of paper, and gives the true mean and the instrument reading.

In the magnetic method of damping, the force varies as the velocity and the true mean is obtained. With liquid and air damping the force varies as the square of the velocity, unless the movement is extremely slow, when it varies nearly as the velocity.

Speed of Aëroplanes.

The speed of the aëroplane through the air is often measured by a Pitot tube and a manometer.

The principle of the Pitot tube is very simple. If the open end of a tube faces the wind, the air wants to pass down the tube; if the tube is closed at

[1] From the first Wilbur Wright memorial lecture delivered before the Aëronautical Society of Great Britain on May 21, by Mr. Horace Darwin, F.R.S.

the other end the air pressure is increased in the tube, and this increase of pressure is a remarkably accurate means of measuring the velocity of the wind. This method is used in Dines's anemometer, and for measuring the velocity of the air in the wind channel at the National Physical Laboratory. In 1903 Dr. Stanton read a paper before the Institution of Civil Engineers (Proc. Inst. C.E., vol. clvi., p. 78) proving the accuracy of this method of measuring air velocity, and improvements have recently been made which give even more satisfactory results. The delicate measurement of the air pressure necessary for the most refined work is made by the tilting water gauge designed by Prof. A. P. Chattock and Mr. J. D. Fry. This is a laboratory instrument of the highest order of precision, and is far too delicate and accurate to be used on a flying machine. It is a difference of pressure that has to be measured—the increase of pressure in the tube, above the air pressure outside—and a second tube transmits this pressure (the static pressure) to the manometer. It is found by experiment that changes in the size of the opening of the Pitot tube, or the thickness of the tube, or the bevelling of its edge, make little or no difference in the pressure. With the opening of

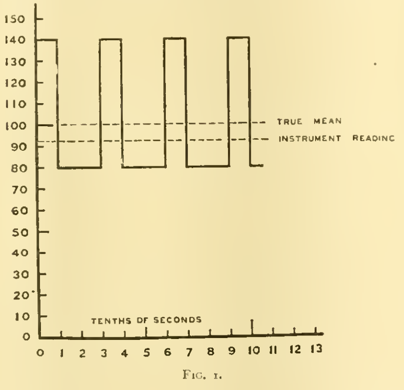

FIG. 1.

the static tube it is different, and its design is important. In the design now adopted at the National Physical Laboratory the pressure obtained is almost exactly what we should expect from theoretical considerations. This is an advantageous simplification, and this form of Pitot tube should be used for all the most refined measurements. But the static tube can be so made that it will give a pressure below the true static pressure, and the Royal Aircraft Factory has made use of this and has increased the manometer readings by 20 per cent. in order to give a more open scale.

The tubes transmitting the pressure can be carried a considerable distance to allow the manometer to be placed in a convenient position for reading; this is often of great importance. If it is found advisable to have a large amount of damping in the manometer it is best to have long tubes of large diameter. This gives the correct form of damping. Short tubes of small diameter will also give a large amount of damping, but in this case the damping force will vary as the square of the velocity of the air in the tube, and the reading will not necessarily be the true mean. For the same reason it is inadvisable to cause damping by throttling the passage of the air by closing a valve, or by means of letting it pass through a small hole in a plate.

If a Pitot tube speed-meter gives the correct speed when flying near the ground level, it will not be correct when flying at a great altitude. The error is caused by the change in the density of the air. As you mount the air becomes less dense because the atmospheric pressure is reduced, and more dense because the temperature falls, and an error of 7 per cent. may be expected at an altitude of 5000 ft.

The simplest form of manometer is a U-tube containing a liquid. The difference of the level of the liquid is then a measure of the difference of the air pressure in the two tubes. For use on an aëroplane this has two drawbacks: the scale is not open enough to read the speed easily and accurately, and tilting of the aëroplane causes an error. Mr. Short, of the Royal Aircraft Factory, has designed a manometer which overcomes both these objections. It is in effect a U-tube manometer; he uses two liquids of different densities, which do not mix, and thus obtains a more open scale. One tube is placed inside the other, and this overcomes the chief error due to the tilting of the aëroplane, leaving only a small secondary error amounting to $1\frac{1}{2}$ per cent. for a displacement of 10° out of the vertical.

If the aëroplane has an upward or downward acceleration or is changing its direction there is an error.

If a Pitot tube is fixed to the tips of the wings of an aëroplane and it is flying in a circle, the speed of the outer wing tip is greater than the speed of the inner wing tip. If these Pitot tubes are joined together by a tube there will be a greater pressure at one end of the tube than at the other, and at first sight we should expect that there would be a flow of air through the tube from the outer to the inner wing tip. But this is not the case, because the aëroplane is moving in a circle and there will be centrifugal force acting on the air in the tube. This will tend to make it flow outwards, and will exactly balance the tendency of the air to flow inwards due to the excess pressure in the Pitot tube on the outer wing tip, and there will be no flow through the tube. If there is a side-slip this statement is only approximately true. For accurate speed measurements at the Royal Aircraft Factory two Pitot tubes are used, one at each wing tip; both are connected to the manometer and the mean speed is given.

An instrument called a yaw-meter was described. It measures the direction in which the air is moving relatively to an aëroplane, and its action depends on the fact that the pressure in a Pitot tube becomes less if it does not directly face the wind. Two Pitot tubes are used, and the indication is independent of the speed of flight.

A method of indicating the speed of ascent or descent was also described.

The Principle of Geometrical Design.

Clerk Maxwell writes:—

"Each solid piece of an instrument is intended to be either fixed or movable, and to have a certain definite shape. It is acted on by its own weight, and other forces, but it ought not to be subjected to unnecessary stresses, for these not only diminish its strength, but (what for scientific purposes may be much more injurious) they alter its figure, and may, by their unexpected changes during the course of an experiment, produce disturbance or confusion in the observations we have to make.

"We have, therefore, to consider the methods of relieving the pieces of an instrument from unnecessary strain, of securing for the fixed parts a determinate position, and of ensuring that the movable parts shall move freely, yet without shake.

"This we may do by attending to the well-known fact in kinematics—'*A rigid body has six degrees of freedom.*'"

Designs in which this principle is carried out may be called geometrical designs. A three-legged table is a geometrical design, and a four-legged table is not. A four-legged table either rocks on two legs, or bends so that all legs touch the floor, and the amount of bending and the pressure of each foot on the floor depends on the stiffness of the table and the evenness of the floor. Every time an ordinary chair is placed in a new position, it takes a new shape. A surface plate is a familiar example of the importance of three supports, and nearly all scientific instruments rest on three feet. Other examples of geometric design were also given.

Good Design and Bad Workmanship.

A most important consideration in a good design is that the instrument shall still work well when the rubbing surfaces get worn or parts get bent, or if the workmanship is not good. With perfect workmanship and a bad design, you may get jamming in the moving pieces and bending of parts which should not bend, and the results obtained will be liable to error and the working unsatisfactory. This consideration brings out most forcibly the advantage of geometrical designs, but also it is a valuable test to all designs. It is a long way from being the only test, but it is always well worth while to consider separately the effects of imperfect workmanship, or the bending of each part and wearing of the rubbing surfaces. Take the case of wear in a wheelbarrow. The axle of the wheel usually consists of two round iron pins running in holes in wooden rails forming the frame of the wheelbarrow. Both the wood and the pins wear; the pin gets smaller but keeps circular, and wears its way into the wood and always fits it properly on the side where pressure is taken. The wheel will work perfectly until either the holes break out of the wood or the pin wears down very small and itself gives way. But sometimes the axle is made differently; an iron rod is fixed to the two wooden rails and passes through a hole bored along the centre of the wheel. With use the iron rod wears on the under side and does not remain circular, the hole in the wheel gets larger; the result is increased friction and a loose and shaky bearing.

The following test was applied to the Rocking Microtome, which has been designed so far as possible on the geometrical method. The iron castings of which it is chiefly made were taken as they left the foundry, were put together with as little work as possible, and it at once cut good sections. This was a severe ordeal, but sections as thin as 0·003 mm. were cut, proving that the instrument still worked with considerable precision.

This test for good design is not the only test, and it may fail. Ball bearings are much used, and when once used for any purpose they continue to be used more and more; this is the best test of a really good mechanical device. All must admire their design, but first-rate workmanship is essential; in this must be included the composition of the steel, the skill in hardening, as well as the accuracy of the figure of the working parts. A ball bearing, however, would be a better thing even than it is at present if it did not require such fine workmanship. It also requires careful mounting, and it is interesting to notice that the recent improvements in ball-bearing design are in the direction of allowing it to work satisfactorily on shafting which may be considerably bent.

The Advantage of Reversing the Parts of a Machine.

An improvement in the design of a machine can often be made by reversing the relative position of two parts of it, or the part that moved can be fixed and the part that was fixed can be made to move. This reversal makes it possible to compare two or more methods, and it is then easy to see which is best. It is advantageous that "the survival of the fittest" should take place early in the life of the machine, and by this means, in fact, it takes place before the design is completed.

In the before-mentioned wheelbarrow it is easy to see which is the best design, and if the designer had deliberately considered whether the iron pins should turn in the wooden rails or whether the iron bar should be fixed, the bad design would never have been made. It is surprising how often this reversal is possible and advantageous, and how difficult it is to realise that it is possible. We are so familiar with a clock in which the frame remains at rest and the hands move that it requires a considerable mental wrench to realise that it is possible and in some cases better that the clock itself should revolve and the hour hand remain at rest. But in recording apparatus it is usual to fix the clockwork in the rotating drum carrying the paper, and to prevent rotation of the hour-hand spindle.

The lecturer concluded:—"I have spoken as a manufacturer of scientific instruments, but my remarks apply equally or even more to the home-made or rather laboratory-made type of instruments. And it is with these that the greatest advances in knowledge have been made. If I could believe that what I have said would be any help to the makers of the wire, cork, and sealing-wax class of instruments, or to the orthodox instrument-maker, I should be glad to think I had done something to advance knowledge."

THE STANDARDISATION OF HYDROMETERS

WE have received from the director of the National Physical Laboratory the following memorandum for publication in NATURE:—

At the present time there appears to be considerable ambiguity as to the bases of standardisation of hydrometers graduated to read directly in specific gravity.

Three different methods have been brought to the notice of the National Physical Laboratory, and it seems desirable to determine which of these three should be considered as standard.

The instruments are in all cases graduated for use in a liquid at a definite temperature—we call this the standard temperature of the instrument—and give the specific gravity of this liquid at some definite temperature, which may or may not be the standard temperature of the instrument, referred to water at the same or at some other temperature.

The following cases have arisen in practice:—

I. (α) The liquid to be tested must be at the standard temperature of the instrument.

(β) The water to which the specific gravity is referred must also be at the standard temperature of the instrument. Thus, if 85° F. be the standard temperature of the instrument[1] the liquid must be at 85° F. when tested, and its specific gravity is referred to water also at 85° F.

II. (α) The liquid to be tested must be at the standard temperature of the instrument.

[1] A more usual value for this temperature of the instrument would be 60° F. or 62° F. The temperature 85° F. is chosen here as an example so as to bring out the differences arising from the various methods of standardisation.

(β) The water to which the specific gravity is referred must be at some other definite temperature, e.g. 60° F., or possibly 4° C., the temperature of maximum density. Thus, if 85° F. as before be the standard temperature of the instrument and 60° F. that of the water, the specific gravity of the liquid at 85° F. is referred to water at 60° F.

III. (α) The liquid to be tested must be at the standard temperature of the instrument.

(β) The graduations are such that they give the value which would be found for the specific gravity of the liquid if it were cooled or heated to some other temperature and referred to water at that[2] temperature. Thus the standard temperature of the instrument might be 85° F. The instrument would then be used at 85° F., but the graduations on the instrument would be such as to give the specific gravity which would be found for the liquid if it were cooled to 60° F., and referred to water at 60° F.

The following table gives the specific gravities of certain sugar solutions, as determined in accordance with these various methods, assuming coefficients of expansion as given in tables issued by the Kaiserliche Normal Eichungs-Kommission of Berlin :—

Solution	I. Specific gravity at 85° F. in terms of water at 85°	II. Specific gravity at 85° F. in terms of water at 60°	III. Specific gravity at 60° F. in terms of water at 60° *
Water ...	1·0000	0·9968	1·0000
Solution A...	1·0496	1·0462	1·0500
,, B...	1·0989	1·0954	1·1000
,, C...	1·1484	1·1447	1·1500

* In this case the liquid to be at 85° when tested, but the instrument is to give its specific gravity when cooled to 60° in terms of water at 60°.

Thus, taking solution C, and supposing in each case the liquid is at 85° F., the instrument will float immersed up to a definite division on the stem. In method I. this division would be marked 1·1484, in method II., 1·1447, and in method III., 1·1500.

Thus there would be a difference of 1·6 degrees of specific gravity between I. and III., and of 5·3 degrees between II. and III., and it is clearly necessary to specify the method of graduation.

There is one obvious objection to the use of method III. In order to graduate an instrument correctly it is necessary to observe its immersion in a liquid at the standard temperature, and then calculate from a knowledge of the coefficient of thermal expansion of the liquid and of its density at some given temperature what its specific gravity at some other temperature will be, and what mark therefore should be put on the stem. No doubt tables could be made up to do this for various liquids and temperatures, but from the point of view of a standardising institution it is preferable that the errors of graduation which have to be determined in the case of instruments sent for test should rest only on observations made during the test and not on a knowledge of the coefficient of expansion of the liquid in which the instrument is to be used.

The instrument is correctly graduated only for a liquid having one definite coefficient of expansion, and cannot be used without error for others.

Of the other two methods, I. and II., method I. has been the usual practice at Kew. The liquid under test and the water to which it is referred are both taken to be at the standard temperature of the instrument, and this, in ordinary practice in England, is about 60°. No. II. has the advantage that the reference temperature of the water is fixed and gives results in agreement with the usual definition of specific gravity, which assumes a fixed temperature for the water.

These notes are circulated with the view of eliciting opinions from makers and users, and also of obtaining information from other countries.

The director of the National Physical Laboratory will be glad to have an expression of opinion from people interested in the subject.

[2] A fourth variation might be added by requiring that in this case the water should not be at the temperature to which the liquid is cooled or heated.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Bristol.—On the nomination of the Society of Merchant Venturers, in the college of which the faculty of engineering of the University is provided and maintained, the council has appointed the Right Hon. Sir William Mather, P.C., a member of the board of that faculty, in succession to the late Sir William H. White, K.C.B.

Cambridge.—The following awards are announced: Harkness Scholarship (geology) for 1913, J. M. Wordie, St. John's College. Frank Smart prizes, J. Line, Emmanuel College (botany); D. J. Gray, King's College (zoology). Wiltshire prize (mineralogy) for 1913, E. V. Appleton, St. John's College; honourable mention, W. E. Evans, St. John's College.

St. Andrews.—The Senatus Academicus has resolved to confer the honorary degree of LL.D. on the following:—Lieut.-Col. Sir Chas. H. Bedford, Dr. George Albert Boulenger, F.R.S., Mr. J. Balfour Browne, K.C., Mr. F. Cornwallis Conybeare, Prof. Herbert J. C. Grierson, and Prof. W. R. Hardie.

The issue of the *London University Gazette* for June 4 gives particulars of the advanced lectures in scientific subjects which have been arranged during the present month for students of the University and others interested. Of those lectures which have still to be delivered may be mentioned a special lecture on the work of the Carnegie Nutrition Laboratory in Boston, to be given in the Physiological Laboratory of the University, South Kensington, on June 20, at 5 p.m., by Prof. F. G. Benedict, director of the Carnegie Laboratory. The admission to the lecture is free, without ticket.

The report of the council for the year 1913 to the members of the City and Guilds of London Institute provides full statistics and particulars of the subscriptions and donations of the great City companies to the institute since its inauguration. The total amount given to the institute during thirty-four years for the purposes of higher education reaches 889,139*l*. Three of the companies—the Goldsmiths', Clothworkers', and Fishmongers'—have each given above 120,000*l*.; eight others have each contributed above 20,000*l*., and other five more than 10,000*l*. The most recent gift is that of the Goldsmiths' Company towards the extension of the City and Guilds (Engineering) College, which is incorporated in the Imperial College of Science and Technology. During the year under review the Goldsmiths' Company supplemented by a further sum of 37,000*l*. its original gift of 50,000*l*., which was commented upon in the last report of the council.

The King Edward VII. British-German Foundation, instituted by Sir Ernest Cassel, decided last year to assist a number of young men of British nationality to prosecute special studies in Germany after the completion of their studies at one of the British universities. The council of the British section of the foundation has just awarded seven studentships with this object in view, and from the list of successful candidates, published in *The Times*, we notice that four of the students will proceed in Germany with scientific research as follows:—Mr. F. H. Smith, Pembroke College, Cambridge, chemical research; Mr. R. S. Wishart, Edinburgh University, chemical research; Mr. A. Cowe, Edinburgh University, neurology and gynæcology; Mr. S. G. Barker, Imperial College of Science and Technology, London University, scientific research in vapour pressures. The studentships are for one year and of the value of 175*l*., and a condition of their tenure is continuous residence in Germany for this period. The cost of these will be defrayed by the German section of the foundation, while the British section is bearing the expense of a limited number of German students who, under a corresponding scheme, will visit this country in the autumn.

In a communication from *The Times* correspondent at Toronto on June 5, it is announced that the report of the Royal Commission on Industrial Training and Technical Education in Canada, instituted three years ago, has now been made public. The report suggests that a fund of 600,000*l*. be provided annually by the Dominion for a period of ten years, and be divided among the provinces on the basis of population for the promotion of higher technical education and industrial training, while for elementary schools teaching manual training and domestic science a grant of 70,000*l*. a year for ten years is recommended. The report also proposes the establishment in each province of a board qualified to carry on industrial training. It advocates the provision of suitable and adequate apparatus and equipment for teaching purposes, the foundation of scholarships for students, the engagement of experts with experience in industrial training, and the creation of central institutions to supplement the work carried on by the provincial and local authorities. Workers in factories whose main task is to attend or to operate machines should, it is suggested, receive instruction which would develop all-round skill and increase their interest beyond the routine of automatic operations. Such training should be provided as will conserve and develop occupations in which skilled handicraft is required. The interests of the rural population should be preserved so far as possible by industrial training and technical education suitable to the needs of its workers. The needs of girls and women for organised instruction and training in housekeeping and home-making under modern industrial conditions should be recognised. The report also recommends that schools for fishermen should be established, and that provision be made for instruction in packing and curing. The distinguishing characteristic of the report is the attention which it gives to the problems of the rural communities.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 12.—Sir Archibald Geikie, K.C.B., president, in the chair.—Commendatore G. **Boni**: Address on recent researches on the Palatine, in relation to geology, ethnology, and physics.—J. G. **Thomson** and D. **Thomson**: The growth and sporulation of the benign and malignant Tertian malarial parasites in the culture tube and in the human host.—Sir David **Bruce**, Majors D. **Harvey** and A. E. **Hamerton**, and Lady **Bruce**: (1) *Plasmodium cephalophi* sp. nov. (2) The trypanosome causing disease in man in Nyasaland. II., Susceptibility of animals to the human strain. (3) Trypanosome diseases of domestic animals in Nyasaland. I., *Trypanosoma simiae* sp. nov. Part ii., The susceptibility of various animals to *Trypanosoma simiae*. (4) Trypanosome diseases of domestic animals in Nyasaland. I., *Trypanosoma simiae* sp. nov. Part iii.

Zoological Society, June 3.—Prof. E. W. MacBride, F.R.S., vice-president, in the chair.—Sir Arthur H. **Church**: Notes on turacin and the turacin-bearers. This paper contains a summary of the chief facts as to the composition, properties, and occurrence of turacin, the soluble crimson pigment of the Musophagidæ. Special stress is laid upon its constancy of composition, the limitation of its occurrence to certain plantain-eaters, and the relation of its spectrum to the spectra of hæmoglobin and chlorophyll. Some current errors concerning turacin are corrected.—Dr. P. Chalmers **Mitchell**: Observations on the anatomy of the shoe-bill (*Balaeniceps rex*). The author showed that Balæniceps and Scopus shared so many anatomical characters, and of these so many occurred also in storks, that if the reasoning generally followed by anatomical ornithologists were adopted, Balæniceps and Scopus must be placed with storks rather than with herons. He submitted, however, that such a method was irrational, unless it were accompanied by a much closer scrutiny of the value of the characters than had hitherto been made or was yet possible, and that for the present Balæniceps must be regarded as the representative of a division equivalent to storks and herons. He thought also that the relation of the Steganopods to these three groups required reconsideration.—T. H. **Withers**: Some Miocene Cirripedes of the genera Hexelasma and Scalpellum from New Zealand. An account is given of the "gigantic Cirripede" of New Zealand, originally described as *Scalpellum aucklandicum*, of which remains have long been known to occur in the Waitemata Beds (Miocene) of Motutapu Island, Auckland Harbour.—Prof. A. **Dendy** and R. W. **Row**: The classification and phylogeny of the Calcareous sponges, with a reference list of all the known species, systematically arranged. This memoir aims at a complete revision of the genera of Calcareous sponges. Fifty recent genera are recognised and diagnosed, and all the described species, amounting to 433, are arranged under these genera. The rejected generic names, which are listed separately, amount to ninety-seven. The fifty accepted genera are grouped in ten families, and Poléjaeff's subdivision into Homocœla and Heterocœla is abandoned.—Surgeon J. C. **Thompson**: Contributions to the anatomy of the Ophidia.—Prof. T. Wingate **Todd**: Observations on Osteomalacia in the zoological collections of Manchester and Cleveland.

Linnean Society, June 5.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Miss L. S. **Gibbs**: A contribution to the flora and plant-formations of Kinabalu and the highlands of British North Borneo.—H. **Scott**: The Histeridæ of the Percy Sladen Expedition to the Seychelles.—Mme. Weber van **Bosse**: Red marine algæ from the Indian Ocean.—J. G. **Needham**: Myrmeleonidæ.—W. L. **Distant**: Rhynchota from the Seychelles. Part I., Heteroptera.—Prof. R. J. Harvey **Gibson**: Mystropetalon, Harv.

Mathematical Society, June 12.—Prof. Love, president, in the chair.—Sir J. **Larmor**: The electromagnetic force on a moving charge in relation to the energy of the field.—Prof. E. **Landau**: Einige Ungleichungen für zweimal differentierbare Funktionen.—G. H. **Hardy** and J. E. **Littlewood**: (1) The fractional part of $n^k\theta$. (2) The trigonometrical series associated with the elliptic θ-functions.—Dr. T. J. I'A. **Bromwich**: Foucault's pendulum.—J. **Hammond**: A certain definite inegral.

Royal Astronomical Society, June 13.—Major E. H. Hills, C.M.G., F.R.S., president, in the chair. F. W. **Dyson** and E. W. **Maunder**: Position of the sun's axis as determined from photographs of the sun from 1874 to 1912, measured at the Royal Observatory, Greenwich. In a previous paper corrections to the position of the axis were deduced from observations of spots crossing the sun's disc; in the present paper the material employed was extended by the consideration of spot groups passing across the further side of the sun. A still more important addition consisted in the observation of the latitudes of spots near the centre of the disc. No change was observed, either with sun-spot cycle or with phase.—A. S. **Eddington**: Preliminary results of observations with the Cookson floating zenith telescope. Mr. Cookson had photographed trails of the same star with reversed positions of the instrument; at Greenwich trails of different stars were taken, a method which brings the trails closer together, and near the centre of the plate. This method considerably reduced the probable error, but there remained discordances, the cause of which was uncertain; there seemed reason to believe that they were atmospheric.—J. A. **Harker**: The origin of solar electricity. A simple apparatus was described with which experiments were made, showing increase of electrical emission in all metals with increasing temperature. The cosmical bearing of the phenomena observed was pointed out.—Prof. E. C. **Pickering**: Some work carried on at the Harvard Observatory, especially the classification of stellar spectra by Miss Cannon. One thousand spectra had been classified by Miss Cannon alone in three years, but with her great experience and by carefully organising the work, Miss Cannon and her staff of assistants were now able to classify 5000 spectra a month. The work to be done was very great; there appeared to be more than 150,000 spectra to be dealt with.—Miss **Cannon**: Classification of spectra of gaseous nebulæ. Many gaseous nebulæ have precisely the character of the spectra of stars of the fifth type.—S. S. **Hough**: Progress of the Cape of Good Hope share in the work of the Astrographic Chart. The catalogue plates were all taken and checked by comparing the overlapping quadrants. Mr. Hough described briefly the other work carried on at the Cape, especially mentioning the high degree of stability of the system of meridian marks used.—Dr. H. N. **Russell**: Studies of stellar evolution, carried on at the Princeton Observatory. Dr. Russell showed diagrams exhibiting the relation between the spectra of stars and their real brightness, that is the brightness which they would have if all were placed at a uniform distance corresponding to a parallax of ten seconds. Interesting relations between colour and brightness were shown by the diagrams.

Cambridge.

Philosophical Society, May 19.—Dr. Shipley, president, in the chair.—Dr. G. F. C. **Searle**: (1) Some methods of measuring the surface tension of soap films. In one method the pressure excess due to a curved soap film is measured by aid of what may be called a "viscosity potentiometer." Air from a gasometer flows through two tubes AB, BC in series. The pressure at A is measured by a manometer; the end C is open to the air. From the junction B a side tube leads to a cup with a horizontal circular rim on which a soap film is placed. On account of the viscosity of the air, there is a fall of pressure along each tube. For a given flow of air, the fall of pressure in either tube is proportional to the length of the tube, and inversely proportional to the fourth power of its internal radius. The excess of the pressure at B over that of the atmosphere causes the film to become part of a sphere. From the distance of the highest point of the film above the plane of the rim and from the radius of the rim, the radius, r, of the film can be computed. (2) A simple method of testing lens systems for aberration. On account of spherical aberration, a lens does not bring to a mathematical point all the rays which have reached it from an object point on its axis. When there is aberration, the emergent beam has at one place a finite minimum cross section called the least circle of aberration; the smaller this circle is the more nearly is the lens free from spherical aberration for the given position of the object point. A metal plate is pierced with three equally spaced circular holes, A, B, C, each about 0·1 cm. in diameter, and the distance AC (measured from centre to centre) is about 2 cm. The holes are illuminated by a flame and their "images" formed by the lens system under test are received upon a very fine ground-glass screen backed by a micrometer scale divided to 0·01 cm.; this scale is viewed by an eyepiece. The examination shows whether the lens is free from spherical aberration or whether it is (1) under-corrected or (2) over-corrected for aberration.—R. D. **Kleeman**: The unstable nature of the ion in a gas. The ions in a gas in thermodynamical equilibrium must at any instant consist of free ions and clusters of various complexities (Proc. Camb. Phil. Soc., vol. xvi., pt. iv., p. 285). In order to obtain some experimental information on the nature of the ions, the ionisation by collision between a gauze and plate was studied, the initial ions being formed outside the space between gauze and plate in a weak field which drew the ions through the gauze. Some of the elementary ions were thus able to form clusters before being seized upon by the strong field producing further ions by collision.—W. A. Douglas **Rudge**: A dust electrical machine. The author has shown that clouds of dust raised by the wind or by artificial means are always strongly charged with electricity, the sign of the charge depending upon the nature of the dust. By a suitable arrangement of apparatus it is possible to get a continuous supply of electricity, by directing a current of air laden with dust through an insulated tube. When the current is passing a stream of sparks, sometimes 6 cm. in length, may be obtained from the tube. Flour, sulphur, road dust, or fine iron filings may be used. The air which escapes from the exit tube of the apparatus is also strongly charged, and if the apparatus is used inside a room the charge may be retained by the air of the room for more than half an hour. The origin of the charge upon the apparatus is probably due to (1) the actual raising of the cloud, (2) friction of the dust against the walls of the tube.—R. **Whiddington**: A mechanical vacuum tube regulator. One of the devices for regulating the speed of kathode rays within a discharge tube is to provide the kathode with a movable glass sheath. The position of the sheath determines the speed of the rays. Experiments are described which show that the inside of the sliding sheath concentrates the cylindrical beam of rays to a fine beam, thus diminishing the effective size of the kathode.

Edinburgh.

Royal Society, May 4.—Sir William Turner, K.C.B., president, in the chair.—Dr. W. S. **Bruce**: The skulls of antarctic seals (Scottish National Antarctic Expedition). The paper contained the measurements of the skulls of the different seals found in the Antarctic, with careful photographs of the skulls in various aspects.—Miss Laura R. **Thornley**: The Bryozoa of the Scottish National Antarctic Expedition. Of the eighty-five species described, three were new to science and six of the remainder had been found in the southern seas for the first time.—W. **Watson**: The compressibility of solutions of certain salts. Dilute solutions of NaOH, KOH, $MgSO_4$, $ZnSO_4$, and Na_2CO_3 were investigated by the electrical-contact method of measuring compressibility. The pressures were from one to one thousand atmospheres, and the temperature was 15° C. Within certain limits the observed compressibilities were found to satisfy Tammann's formula,

$$\frac{1}{v_0}\frac{dv}{dp}=\frac{A}{B+p+\Delta k}\cdot\frac{1}{v_{\Delta k}},$$

where Δk is the internal pressure due to the added salt and A and B are constants.

May 18.—Prof. T. Hudson Beare, vice-president, in the chair.—J. H. Harvey **Pirie**: Deep-sea deposits of the Weddell Sea and South Atlantic Ocean. The *Scotia* collections included three main types, viz. globigerina ooze, diatom ooze, and glacial muds and clays. The latter differs from most blue muds of terrigenous origin mainly in the character of its finest constituents—"rock feons"—and in the irregular size of its coarser components, this being due to its distribution by floating ice. A peculiar feature is the absence of diatoms, although they flourish in the surface waters over it. They seem to be carried off northwards by currents set up by the melting ice to be deposited in the diatom onze band to the north.—F. Gordon **Pearcey**: Foraminifera collected by the *Scotia*. A record of 267 species, including eleven new forms, separated from the deposits. The collection is very rich in arenaceous forms (to which most of the new species belong) from the glacial deposits. It includes also examples of such rare forms as *Verammosphaera fusca*.—Miss Margaret **Moir**: The effect of thermal treatment and the effect of longitudinal strain in inducing a sensitive state in certain magnetic materials. Under certain conditions it was found that longitudinal strain and heating had very similar effects on the manner in which the steels experimented with responded, as regards their induction, to the magnetising force acting on them.

PARIS.

Academy of Sciences, June 2.—M. F. Guyon in the chair.—E. L. **Bouvier**: The genera Pseudibacus and Nisto.—M. de **Forcrand**: The Trouton quotient and the molecular heat of vaporisation of pure bodies boiling at high temperatures. In connection with a modified Trouton formula recently proposed by the author, the experimental methods of determining the latent heat of vaporisation at high temperatures are discussed, and preference is given to the vapour-pressure method, with application of the Clapeyron equation. Experimental data for mercury, cadmium, zinc, bismuth, lead, silver, tin, and copper are compared with those deduced from the Forcrand formula.—M. **Ciamician** was elected a correspondant for the section of chemistry in the place of the late Lecoq de Boisbaudran.—J. **Bosler**: The spectrum of the Schaumasse comet 1913*a*. Three condensations are clearly shown on the spectrographs, the blue band of the Swan spectrum, the cyanogen band (λ 388), and a large band λ 400 to λ 407.—M. **Borrelly**: Observations of the comet 1913*a* (Schaumasse) made at the Observatory of Marseilles with the comet-finder. Positions of the comet and comparison stars are given for May 9, 10, 15, 22, 29, and 30.—M. **Coggia**: Observations of the comet 1913*a* (Schaumasse) made at the Observatory of Marseilles with the Eichens 26-cm. equatorial. Positions for May 26, 27, 28, and 29.—N. **Lusin**: The convergence of Fourier's trigonometrical series.—Paul **Lévy**: The integration of functional partial differential equations.—Jacques **Chapelon**: The numbers of classes of positive binary quadratic forms with negative determinant.—Vasilesco **Karpen**: Hovering flight.—Louis **Roy**: Complement to two recent notes on the movement of indefinite viscous media.—Ernest **Esclangon**: A temperature regulator. The regulator consists of a circular glass tube containing mercury and a volatile liquid supported on a knife edge at the centre of the circle formed by the tube. It is in indifferent equilibrium, and can be rendered extremely sensitive. Curves are given showing the behaviour of this as compared with an ordinary bimetallic regulator.—R. **Détrait**: The slip of liquids on the walls of capillary tubes. The flow of two liquids, petrol and water, was studied in tubes of glass, wetted by both liquids, and sulphur, wetted by the petrol only. H. **Parenty**: The reconstitution photographically of certain invisible details of ancient drawings. Lighting in various ways a *Décollation de Saint Jean Baptiste*, attributed to Rubens, the signature *Rubês* appeared, the first two letters in all the negatives, the last three in one or other of them.—Pierre **Weiss**: The kinetic theory of the paramagnetism of crystals.—G. **Friedel**: The general law of the diffraction of the Röntgen rays by crystals.—A. **Perot**: The movement of the light centres in electric discharges in Geissler tubes.—G. **Malfitano** and Mlle. A. **Moschkoff**: The deflocculation of starch and the solution of glucose.—Edouard **Bauer**: 1-Benzoyl-2-phenyl-Δ_1-*cyclo*pentene. With sodium amide this compound behaves similarly to benzophenone, breaking up partially into 2-phenyl-Δ_1-*cyclo*pentene-1-carboxylic acid and benzene and partially into 1-phenyl-Δ_1-*cyclo*pentene and benzamide.—E. **Léger** and Ferdinand **Roques**: Contribution to the study of carpiline or pilosine.—M. **Chaillol**: Researches on the morphology of the bud in Labiates with subterranean stolons.—E. **Boucherie**: The cytological phenomena and sporogenesis in *Barbula muralis*.—M. **Molliard**: Semi-parasitic *Lepidium sativum* produced experimentally.—D. **Chouchak**: The penetration of different forms of nitrogen in plants; adsorption phenomena.—N. **Patouillard**: A conidiferous Septobasidium.—J. M. **Lahy**: The physical signs of professional superiority in dactylographs.—L. **Bordas**: The gizzard of the Dytiscideæ.—A. **Gruvel**: Fishing for the large Cetaceans on the western coast of Africa. The present rate of destruction is so great that an international control is suggested.—Edouard **Chatton**: Spontaneous septicemia due to the cocobacillus in the cockchafer and silkworm. Auguste **Lumière** and Jean **Chevrotier**: The toxicity of antityphoid vaccines. The vaccines studied proved to be very slightly toxic for the guinea-pig.—M. **Dalloni**: The marine Oligocene and its fauna in Algeria.—Alphonse **Berget**: The exact position of the continental pole of the earth.

June 9.—M. F. Guyon in the chair.—E. **Jungfleisch** and L. **Brunel**: The reactions between water and sulphurous acid at varying temperatures. The formation of hyposulphurous acid. Aqueous solutions containing from 20 per cent. to 21 per cent. of sulphur dioxide were heated to various temperatures. At about 150° C. sulphur and sulphuric acid were formed, an equilibrium being reached in twenty days. A study of the reaction at lower temperatures showed that hyposulphurous acid was formed; this then decomposes into sulphur and sulphuric acid.—Prince Albert de **Monaco**: The twenty-fifth scientific expedition (*Hirondelle II.*). Results obtained in the neighbourhood of the Azores and Madeira in the summer of 1912.—Pierre **Duhem**: An elementary remark on the problem of spherical waves.—Paul **Sabatier** and A. **Mailhe**: The use of calcium carbonate as a catalyser of the organic acids and their anhydrides. A column of precipitated chalk, 15 cm. to 40 cm. long, and maintained at a temperature of 450° C. to 500° C., gives a fair yield of ketones when the vapours of the acids are led over it. Acetic acid and propionic acid give very good yields, but there is an increase in the secondary products as the molecular weight of the acid is higher. Benzoic acid gives no benzophenone, but mixtures of benzoic and fatty acids give fair yields of the mixed fatty-aromatic ketones.—A. de **Gramont** was elected a member of the section of free academicians in succession to the late Alfred Picard.—J. **Guillaume**: Observation of the occultation of a star of the eighth magnitude by Jupiter made at the Observatory of Lyons.—J. **Guillaume**: A curious aspect of the third satellite of Jupiter. Instead of the usual round disc the satellite Ganymede presented a gibbous appearance recalling that of Mars at certain periods. Two illustrations of the satellite are given.—L. **Godeaux**: The classification of the involutions of genus 1 belonging to a surface of genus 1.—A. **Buhl**: Formulæ analogous to the formula of Stokes.—Th. **Got**: The fundamental domains of certain Fuchsian groups.—M. **Schwarz** and M. **Villatte**: The first determination of the difference of longitude by wireless telegraphy in western French Africa. The stations were Kissidougou and Conakry.—A. **Magnan**: Data for the construction of an ideal monoplane based on the flight of birds.—M. **Levavasseur** and M. **Gastambide**: An aëroparachute.—Eugène **Bloch**: The principle of an electrostatic motor. An ordinary quadrant electrometer is modified to serve as a motor.—M. de **Broglie**: The diffraction and reflection of the Röntgen rays.—Jacques **Carvallo**: The electrical conductivity of some pure liquids: ammonia, acetone, ethyl and methyl alcohol. The method used was to seal up the purified liquids in glass tubes furnished with electrodes, and apply a constant electromotive force. The liquid is purified by the action of the current, without, however, any electrolytic phenomena being observable, and the current is noted as a function of the time and voltage.—A. **Tian**: The determination of the order of a photochemical reaction. An attempt to elucidate the effect of absorption on the reaction velocity.—Eugène **Fouard**: A law of tonometry and its consequence as regards the ionic theory.—P. **Leroux**: Magnetic study of the constitution of some antimony alloys. Curves are given for the tin-antimony and lead-antimony alloys.—Daniel **Berthelot** and Henry **Gaudechon**: The photochemical synthesis of a new compound, carbon oxycyanide, by means of ultra-violet light. Mixtures of carbon monoxide and cyanogen are acted upon by ultra-violet light of wave-length less than $0 \cdot 25\mu$, the gases combining in equal volumes. The substance formed is gaseous at about 100° C., and solid at the ordinary temperatures. An analysis, combined with a study of the reactions of this compound, shows that it is carbonyl cyanide, $CO(CN)_2$, analogous with carbonyl chloride.—F. **Bourion** and A. **Deshayes**: The quantitative separation of iron and chromium.—H. **Copaux**: The constitution of the para-molybdates and the para-tungstates.—Léon **Guillet**: The transformation points and the structure of nickel-chrome steels.—Jean **Nivière**: The preparation of diglyceric alcohol.—Marcel **Godchot** and Félix **Taboury**: Some derivatives of β-methyl*cyclo*pentanone. The preparation of the monochloro-derivative and some substances obtained from this are described.—A. **Guilliermond**: New observations on the chondriome of fungi.—D. **Chouchak**: The absorption of different forms of nitrogen by plants; the influence of the medium. The absorption of mineral or organic nitrogen by young wheat plants does not depend immediately upon the living material. It is determined by substances which are contained in the roots and which are not removed by boiling water.—R. **Argaud**: A directly excitable endocardiac region.—Jacques **Mawas**: Action of the traction of the zonule on the general configuration of the human crystalline lens. The possibility of flattening the periphery of the crystalline lens during accommodation.—Em. **Bourquelot** and H. **Hérissey**: The biochemical synthesis with the aid of emulsin of a glucoside isomeric with salacin. β-Salicylglucoside.—L. **Cayeux**: The meaning of mineral gravels included in the Hettangian iron deposits of Burgundy.—Jean **Groth**: The southern border of the Iberian Meseta.—Lucien **Mayet** and Joseph **Mazenot**: The discovery of a prehistoric cave of the Aurignacian age at Brancion (Saone-et-Loire). The cave showed three different archæological levels and a fairly uniform fauna of the middle Quaternary.

CAPE TOWN.

Royal Society of South Africa, April 16.—The president in the chair.—Miss E. L. **Stephens**: A new species of Hæmatoxylon (Leguminosæ-Cæsalpineæ) from Great Namaqualand. The discovery of a South African species of Hæmatoxylin is of particular interest, as the genus has hitherto been represented only by one species—*H. campecheanum*, L., the log-wood tree, a native of Mexico, Central America, the northern parts of South America, and the West Indies. The species here described was found among rocks near Holoog, in Great Namaqualand, by Dr. H. H. W. Pearson, in February, 1909, during the Percy Sladen Memorial Expedition in South-West Africa, 1908–9. It is a shrub, 1–1·5 metres high, and it differs from *H. campecheanum* by its shrubby habit, its more or less pilose and glandular young parts and inflorescence, its smaller leaves, its longer flowered and terminal inflorescence, its bilabiate calyx, and its longer petals and stamens. On a more recent expedition, Dr. Pearson has obtained some wood of this species, which has yielded the characteristic log-wood dye.—G. **Rattray**: Notes on the pollination of some South African Cycads. *Encephalartos Altensteinii*, Lehm., is pollinated by insect agency, the pollen bearer being a weevil belonging to the genus Phlæophagus. Anemophily may still occasionally occur in this species. *E. villosus*, Lehm., from its habitat and cone structure, appears to be exclusively entomophilous. No evidence of entomophily has been found in *Stangeria Katzeri*, Rgl.—R. A. **Dümmer**: A synopsis of the species of Lotononis and of Pleiospora.—T. **Muir**: Note on an overlooked theorem regarding the product of two determinants of different orders.—R. T. A. **Innes**: Note on the Newcomb operators used in the development of the perturbative function.

BOOKS RECEIVED.

Herpetologia Europaea. By Dr. E. Schreiber. Pp. 54. (Jena: G. Fischer.) 2 marks.

County Borough of Halifax. Bankfield Museum Notes. Second Series. No. 2, Ancient Egyptian and Greek Looms. By H. Ling Roth. Pp. 41 + plate. (Halifax: F. King and Sons, Ltd.) 2*s*. 6*d*.

National Antarctic Expedition, 1901–4. Meteorology. Part ii. Prepared in the Meteorological Office, under the superintendence of M. W. C. Hepworth. Pp. 26 + charts. (London: The Royal Society.)

Konstitutions-Formeln der organischen Chemie in graphischer Darstellung. By J. Loschmidt. Edited by R. Anschütz. Pp. 154. (Leipzig: W. Engelmann.) 5 marks.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. 43 and 44 Lief. (Jena: G. Fischer.) 5 marks each Lief.

Die Chemie als mathematisches Problem. By C. Mezger. Pp. 108. (Metz: G. Scriba.) 3 marks.

Das selbstgefertigte Lichtbild. By W. Dix. Pp. 70. (Leipzig: Quelle and Meyer.) 1 mark.

Ausländische Kultur- und Nutzpflanzen. By L. Trinkwalter. Pp. vi + 120. (Leipzig: Quelle and Meyer.) 2.40 marks.

Methodik des chemischen Unterrichts. By Dr. K. Scheid. Pp. xv+448. (Leipzig: Quelle and Meyer.) 10 marks.

Probleme der physiologischen und pathologischen Chemie. By Dr. O. von Fürth. II. Band. Stoffwechsellehre. Pp. xiv+717. (Leipzig: F. C. W. Vogel.) 23 marks.

Guy Mannering, or the Astrologer. By Sir Walter Scott, with Introduction and Notes by J. H. Boardman. Pp. xxx+482. (London: A. and C. Black.) 2s.

Geological Survey of New Jersey. Bulletin 8: Annual Administrative Report of the State Geologist for the Year 1912, including a Second Report on Shark River Inlet, by C. C. Vermeule, and a List of New Bench Marks. Pp. 103. (Trenton, N.J.: MacCrellish and Quigley.)

Geological Survey of New Jersey. Bulletin 9: A Preliminary Report of the Archæological Survey of the State of New Jersey made by the Department of Anthropology in the American Museum of Natural History, compiled by A. Skinner and M. Schrabisch. Pp. 94+map. (Trenton, N.J.: MacCrellish and Quigley.)

Chemie, allgemeine Kristallographie und Mineralogie. By E. v. Meyer, C. Engler, L. Wöhler, O. Wallach and others. Pp. xiv+663. (Leipzig and Berlin: B. G. Teubner.) 21 marks.

Documents of British History, A.D. 1815–1900. By M. W. Keatinge and N. L. Frazer. Pp. 77. (London: A. and C. Black.) 8*d*.

Récits et Compositions d'après l'Image. By M. Anceau and E. Magee. Pp. 33+14 plates. (London: A. and C. Black.) 6*d*.

Zoology. By Prof. E. Brucker. Pp. xiii+219. (London: Constable and Co., Ltd.) 2*s*. net.

Department of the Interior. U.S. Geological Survey. Mineral Resources of the United States. Calendar Year 1911. Part i., Metals. Pp. 1018. Part ii., Non-Metals. Pp. 1224+maps. (Washington: Government Printing Office.)

Department of the Interior. U.S. Geological Survey. Water Supply Paper. 259, 293, 297, 300, 310, 311, 313, 316. (Washington: Government Printing Office.)

Department of the Interior. U.S. Geological Survey. Bulletin. 502, 503, 510, 521. (Washington: Government Printing Office.)

Mechanics and Heat. By J. Duncan. Pp. xiii+381. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*.

Principles and Practice of School Gardening. By A. Logan. Pp. xv+313. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*.

U.S. Department of Agriculture. Weather Bureau. Report of the Chief of the Weather Bureau, 1911–12. Pp. 272+4 charts. (Washington: Government Printing Office.)

DIARY OF SOCIETIES.

THURSDAY, JUNE 19.

ROYAL SOCIETY, at 4.30.—Atomic Specific Heats between the Boiling Points of Liquid Nitrogen and Hydrogen. I. The Mean Atomic Specific Heats at 50° Absolute of the Elements—a Periodic Function of the Atomic Weights: Sir James Dewar.—An Active Modification of Nitrogen produced by the Electric Discharge. V.: Hon. R. J. Strutt.—The Electrical Emissivity and Disintegration of Hot Metals: Dr. J. A. Harker and Dr G W. C. Kaye.—A Method of Measuring the Viscosity of the Vapours of Volatile Liquids, with an Application to Bromine: Dr. A. O. Rankine—The Efficiency of Selenium as a Detector of Light: E. E. Fournier d'Albe.—The Hall Effect in Liquid Electrolytes: A. E. Oxley.—The Displacements of the Particles and their Paths in Some Cases of Two-dimensional Motion of a Frictionless Liquid: Prof. W. B. Morton.—The Diurnal Variations of the Earth's Magnetism produced by the Moon and Sun: S. Chapman.—The Electric Effect of Rotating a Magnetic Insulator in a Magnetic Field: Prof. H. A. Wilson and Marjorie Wilson.—The Magnetic Materials in Claywares: A. Hopwood.—Synthesis of the Anhydrides of α Aminoacyl Glucosamines: A. Hopwood and C. Weizmann.—The Flexure of Telescope Mirror-discs arising from their Weight, and its Influence upon Resolving Power: H. S. Jones.—(1) Fourier Series and Functions of Bounded Variation; (2) A Condition that a Trigonometrical Series should have a certain Form; (3) Trigonometrical Series the Cesaro Partial Summations of which Oscillate Finitely: Prof. W. H. Young.

LINNEAN SOCIETY, at 8.—Impressions of the Feeding-tracks of *Limax maximus* and *Helix aspersa*: Mrs. Longstaff.—African Species of the Genus Crotalaria: E. G. Baker.—Aphareocaris, nom. nov. (Aphareus, Paulson), a Genus of the Crustacean Family Sergestidæ: Dr. W. T. Calman.—Water-colour Drawings of Australian and South African Plants: Miss Fuller.—An Anatomical Study of the Cone-genus Lepidostrobus: Dr. Agnes Arber.—Fresh-water Rhizopoda from North and South America: G. H. Wailes.—A Revision of the Genus Symphytum, Tourn.: Cedric Bucknall.—Some New British Plants: Dr. C. E. Moss.

MONDAY, JUNE 23.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A Geographical Excursion across the United States: G. Chisholm, H. O. Beckit, and A. G. Ogilvie.

WEDNESDAY, JUNE 25.

GEOLOGICAL SOCIETY, at 8.—The Miocene Beds of the Victoria Nyanza and the Geology of the Country between the Lake and the Kisii Highlands: Dr. F. Oswald.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, JUNE 26.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Light Sensations and the Theory of Forced Vibrations: Dr. G. J. Burch.—The Fluctuation in the Ionisation due to γ Rays: P. W. Burbidge.—The Force Exerted on a Magnetic Particle by a Varying Electric Field: J. G. Leathem.—The Luminosity Curve of a Colour-blind Observer: Dr. W. Watson—A Critical Study of Spectral Series. Part iii. The Atomic Weight Term, and its Import in the Constitution of Spectra: Prof. W. M. Hicks.—A Band Spectrum attributed to Carbon Monosulphide: L. C. Martin.—Phosphorescence of Mercury Vapour after Removal of the Exciting Light: F. S. Phillips. *And other Papers*.

FRIDAY, JUNE 27.

PHYSICAL SOCIETY, at 5.

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Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, JUNE 26, 1913.

ORGANIC CHEMISTRY IN MANUFACTURES.

Industrial and Manufacturing Chemistry, Organic. A Practical Treatise. By Dr. Geoffrey Martin. Assisted by Wm. Barbour, T. Beacall, and others. Pp. xx + 726 + plates. (London: Crosby Lockwood and Son, 1913.) Price 21*s.* net.

THE editor of this volume has set himself a rather formidable task. His aim has been "to cover the whole range of subjects," based on organic chemistry, with which the industrial chemist and the manufacturer are usually concerned. In pursuance of this aim the book is arranged with the intention of meeting "the requirements of all business and practical men interested in chemical processes"; and the list of these given includes "manufacturers, consulting chemists, chemical engineers, patent workers, inventors, technical lawyers, students in technical institutions, lecturers on technology, fire insurance inspectors, and others." This is a somewhat motley crew to cater for; but a good attempt has been made to do it, and on the whole a successful one.

The text is divided into twenty-three sections, each dealing with one branch of chemical industry —*e.g.* the sugar industry, the cellulose industry, and so on. With so large a number, even in a work of 700 pages, there could be no such detailed and comprehensive treatment of the subjects as is found in works devoted to only one or two— as, for instance, Lunge's treatise on coal-tar and ammonia. Nevertheless, the volume is not a mere dictionary. Space for detailed discussion and for chemical formulæ, even complicated structural formulæ, is not begrudged (see, for example, the chapter on synthetic dyes); and there are plenty of diagrams and photographs.

A number of experts have collaborated with the editor in the production of the book, and contribute authoritative articles on their special subjects. A very good list of references to the literature of each branch is supplied; this will often be a valuable help to users of the book. Statistics of production, value, imports and exports are given, and frequent references to patents. Furthermore, it is claimed that much of the information respecting the processes is now published for the first time, many descriptions of methods and modern plant having been privately supplied.

As a typical section dealing with well-established manufactures may be instanced that devoted to the fermentation industries. In about 100 pages this gives a good condensed account of enzymes and ferments, and of their applications to the production of wine, beer, alcohol, vinegar, lactic acid, and butyric acid. It includes an article on modern distilling plant, in which the principles of the "continuous" stills are lucidly explained, and illustrated with photographs and lettered diagrams. A subsection of different type is that on the new industry of synthetic rubber. Here the descriptions are largely given by means of chemical formulæ; apparatus is represented by a small form of chlorinating still only. The various methods of obtaining butadiene and its homologues (for example, from butyl alcohol, petroleum, aldehyde, phenol, acetylene, turpentine, starch, or acetone) are explained at some length, together with the processes of polymerising the products to form synthetic rubber.

In addition to the larger industries dealt with— sugar, oils and fats, dyes, explosives, coal-tar products, and so on—there are articles devoted to smaller branches such as inks, glue and albumen, synthetic drugs, and photographic chemicals. The author directs attention to minor industries on account of their potential importance in some cases as the germs of future large undertakings, remarking that they often afford through absence of competition larger profits than those of fully-developed manufactures.

The impression gained on reading through a number of the sections is that a very good outline of the subject is presented, but one that would often want filling up. Looking at the work for a moment from the point of view of a young chemist who contemplates taking up some branch of chemical technology, one may say that the descriptions would serve as an excellent introduction, and the list of books indicated would show him where to supplement his knowledge to any extent he might require.

Very few slips of importance have been noted. There is an error on p. 281, where the composition of "industrial methylated spirit" is given quite wrongly. Such phrases as "the majority of the vinegar" (p. 315), "the great majority of the formaldehyde" (p. 375), "potato manufacturers" (p. 176) are rather slipshod; and it should surely be unnecessary (p. 638) to explain 0·023 as "($\frac{23}{1000}$)." Nor was it really necessary to tell readers four times on the same page (314) that the fusel oils obtainable by Fernbach's fermentation process can be produced at 35*l.* to 45*l.* per ton.

C. S.

THE ANIMALS OF THE ANCIENTS.

Die antike Tierwelt. By Otto Keller. Zweiter Band: Vogel, Reptilien, Fische, Insekten, etc. Pp. xv+618+2 plates. (Leipzig: W. Engelmann, 1913.) Price 17 marks.

EVERYONE interested in the identification of the species of animals known to the ancients should be grateful to Dr. Keller for carrying to completion an exceedingly laborious task, the difficulties and perplexities of which can only be realised fully by those who have essayed investigations of a kindred nature. Exception may indeed be taken to some of his conclusions—as was pointed out in our review of the first volume—but the general results of the work are of the highest value and importance, and form a solid foundation on which superstructures may be laid later.

As the first volume was devoted solely to mammals, all the other groups of animals have had to come in the one now before us. Anything like a detailed review of such a work is manifestly impossible in the space at our disposal, and it must consequently suffice to refer to a few points of special interest. Among such is the statement that the golden pheasant, which was occasionally brought from China to ancient Greece and Rome, was identified, doubtless on account of its rarity, with the mythical phœnix (*phoinix*) of the Egyptians. And this leads to the query whether there is any connection between phœnix and Phœnicopterus (*phoinikopteros*), the name of the flamingo, and between both and Phœnicia—the land of the palm-tree (*phoinix*).

Dr. Keller has, of course, much to tell us about snakes, and it is interesting to note that, in addition to the cobra and the horned viper, he has been able to identify the Æsculapian snake among the species familiar to the ancients. Incidentally it is mentioned that viper (Vipera) is an abbreviated form of *vivipera,* that *aspis* comes from *sepa* (doubtless connected with *seps*), the name of a very poisonous snake; and that *coluber* and *colubra* are derivates from *scolopendra,* a name now assigned to the centipedes. The blind-snake (Typhlops) of the ancients appears to have been the amphisbæna, and not the wormlike species now classed under the former name. Crocodile (or "korkodile") appears to have been used in early days in a more elastic sense than at present, having been applied, with the prefix "land," to the great monitor-lizards, as well as to the animals to which it rightly pertains.

From the section on insects we learn, with regret, that the *melolontha* of Aristotle is neither the cockchafer nor the rose-chafer, but, as demonstrated by the statement that its grubs feed on dung, the dor-beetle, and therefore a near relative of the sacred scarab, of which a full account is given. Did space permit, we would fain quote the author's observations on the pearls and pearl-fisheries of the ancients, particularly the famous pearls of Cleopatra; but as it is, we must refer the reader to the book itself, which is a very mine of etymological and antiquarian information.

R. L.

MOSQUITOES.

The Mosquitoes of North and Central America and the West Indies. By L. O. Howard, H. G. Dyar, and F. Knab. Vol. i., pp. vii+520. Vol. ii., pp. x+150 plates. (Carnegie Institution of Washington, 1912.)

IT is with pleasure that we are able, at last, to announce the appearance of this work. Its publication was expected some few years ago, but, as stated by the authors in their introduction, the material accumulated at this time was by no means complete, and, in order to enhance its value, investigations were continued over a considerably extended period.

Under the title of "A General Consideration of Mosquitoes, Their Habits and Their Relationship to the Human Species" we have in vol. i. a very comprehensive work relating to the subjects under this heading. At the outset, however, we regret to note that the well-known scientific names of two common disease-bearing forms have undergone drastic treatment—*Stegomyia fasciata,* Fabr., being referred to as *Aëdes calopus,* Mg., and *Culex fatigans,* Wied., as *Culex quinquefasciatus,* Say. It is indeed unfortunate that this should be the case with these important species, as much confusion inevitably arises, and it is a question whether, as regards the specific names, the law of priority should be so rigidly adhered to in such circumstances. The validity of the genus Stegomyia is a point for the systematist to decide, but at present its abolition appears to be somewhat premature. The authors direct attention to these changes, and also state that *Anopheles maculipennis* is confined to the Old World, and does not occur in America, the form previously known under this name not being referable to the species, and, in fact, comprising two distinct species, viz. *A. quadrimaculatus* and *A. occidentalis.*

The text very suitably opens with an interesting résumé of the earlier literature and work concerning these insects, and is followed by some eighty pages relating to the morphology of the adult and other stages in the life-cycle. This is entered into in detail, and includes an extensive account of the thoracic structure of the adult; it also contains extracts from numerous workers, and, owing to the limited time available, the portion relating to the internal anatomy has been taken entirely from Stephens and Christophers's work on malaria, &c. The bionomics and natural enemies are next considered, and prove extremely interesting and instructive, much original work having been performed, especially in connection with the former subject. A few pages on technique follow, and we then reach the part dealing with the relation of mosquitoes to man. This, of necessity a somewhat lengthy contribution, covers some 130 pages, and deals successively with the carrying of disease by mosquitoes in general, malaria, yellow fever, dengue, filariasis, suggested relations with other diseases, and the effect of mosquito bites.

Under malaria an account is given of the organisms concerned in its production, and of the demonstration of its carriage; thirty-three species of Anopheles, some of doubtful validity, being cited as transmitters. The general biology of the Anopheline mosquitoes is also satisfactorily dealt with, and the section concludes with reference to the distribution, appearance, and disappearance of the disease. Yellow fever is treated on similar lines, the bionomics of the mosquito, under the name of *Aëdes calopus*, being considered in great detail. As regards filariasis, fourteen species are enumerated, and have apparently been directly incriminated as transmitting agents.

More than one hundred pages are devoted to the consideration of economic loss from mosquitoes, the subject being discussed in relation to disease, real estate, and agriculture. Under this section, too, we find references to the flight and transportation of these flies, and lastly an exhaustive treatise on protective and remedial work in connection with mosquitoes generally. The volume concludes with numerous examples of mosquito control and an extensive bibliography.

Vol. ii. is devoted exclusively to plates. These deal with the structure of the male genital organs of a large number of species, the wings of certain Anophelines, and the earlier stages in the life-cycle. Illustrations are given of numerous species of larvæ, including no fewer than fifty-nine plates relating to their detailed structure. Many of the plates are beautifully executed, and the authors are to be congratulated upon the production of this volume, which points out very clearly the large amount of original work performed.

The work will undoubtedly prove a most valuable addition to the literature of the subject, and will be heartily welcomed by all who are interested in these noxious insects.

TWO FRENCH MATHEMATICAL BOOKS.

(1) *Notions de Mathématiques.* By Prof. A. Sainte-Laguë. Avec Préface de Prof. G. Kœnigs. Pp. vii + 512. (Paris: A. Hermann et Fils, 1913.) Price 7 francs.

(2) *Propriétés Cinématiques Fondamentales des Vibrations.* By M. Guillet. Notes de Dr. M. M. Aubert. Pp. 405. (Paris: Gauthier-Villars, 1913.) Price 16 francs.

(1) THE development of mathematical teaching in this country has been greatly influenced during the last decade by foreign methods. For this, if for no other reason, English teachers will do wisely to watch the evolution of these methods, and this can most easily be done by studying the tendencies of recent text-books.

M. Sainte-Laguë's work on the elements of mathematics is one which will repay such study. Unlike the majority of school-books dealing with this subject, it is not intended for the beginner, but aims at giving a condensed account of results and processes essential to those who have to use mathematics in simple practical applications.

The book is divided into four parts, devoted respectively to arithmetic, algebra, trigonometry, and geometry. Those principles which are continually used in practical applications are kept to the front, and exercises which merely require skill in manipulation are generally excluded. Thus the algebra contains no reference to permutations and combinations, and the binomial and exponential theorems are left to a more advanced stage. On the other hand, the use of logarithms and of the slide rule is explained, and the section on arithmetic contains a valuable chapter on errors and approximate calculations.

It is remarkable that, although the derived function is used and defined, no use is made of the classical notation of the differential and integral calculus. In the section on trigonometry the discussion of the inscribed and circumscribed circles is omitted, and the solution of triangles is compressed into a very few pages. One or two results of spherical trigonometry are included.

The book works throughout in *grades,* instead of degrees; to the English reader this will certainly prove a stumbling-block. The grade has never won recognition outside France, and has not displaced the degree for astronomical purposes.

The section on geometry is the longest in the book. Space geometry is introduced very early. The method of superposition is employed throughout, and the theory of parallels is based on the notion of the motion of translation of a rigid body. Although, according to the best authorities, this may be faulty from the logical point of view, it is probably psychologically sound. There are also chapters on graphical constructions, on plan and elevation, and on contour lines. The work concludes with a section on kinematics. A good set of graduated examples, together with numerical tables and formulæ, will be found at the end.

(2) M. Guillet's book on vibrations is of the nature of a monograph in which the mathematics of "small oscillations" have been collected and classified, with numerous illustrations taken from the theories of light, sound, and electromagnetism.

The whole is a reprint from notes taken by Dr. M. M. Aubert of lectures given in the University of Paris by the author. The first part of the book deals with the theory of simple harmonic motion, free and damped. Several chapters are devoted to the composition of such motions, of plane and elliptically-polarised vibrations, and to phenomena of interference. A number of examples of the calculation of differences of path are given, having special reference to well-known problems of diffraction.

The second part deals with the propagation of waves in elastic solids and fluids. The author establishes the equations of equilibrium and small motion of an elastic solid, and deduces solutions of the problems of flexure and torsion in the simplest cases. He considers the propagation of dilatational and distortional waves in elastic media, and also the vibrations of rods and wires.

The book concludes with a consideration of the elastic-solid theory of the luminiferous æther, the elastic constants being adjusted to give Lord Kelvin's well-known "contractile" æther; certain vectors found are then interpreted in terms of the electromagnetic theory.

A work of this nature, which touches upon a number of different theories, is always liable to fall into the defect of "scrappiness," and it cannot be said that the present volume altogether escapes this reproach; it is, however, both instructive and stimulating, and contains a great deal of valuable information—information which is usually widely scattered, and therefore largely unavailable for the learner. In this sense the book supplies a distinct want. L. N. G. F.

OUR BOOKSHELF.

Abhandlungen und Vorträge zur Geschichte der Naturwissenschaften. By Prof. E. O. von Lippmann. Zweiter Band. Pp. x+491. (Leipzig: Veit and Co., 1913.) Price 8 marks.

PROF. VON LIPPMANN presents in this volume a second collection of the valuable historical studies which he has contributed to *Chemiker-Zeitung* and other periodicals. The articles are thirty-six in number, and, like those published in the former volume, range over the whole history of chemistry. They exhibit the author as a man of wonderfully wide learning and remarkable security of scholarship.

The studies are divided into eight sections upon a chronological basis. The first section contains an analysis, from the point of view of chemical knowledge, of the famous medical papyrus, of the sixteenth centry B.C., discovered by Ebers at Luxor. A second article, on the term "caput mortuum" (=iron oxide), throws interesting light upon the mystical interpretations of chemical phenomena which originated, like the "black art" itself, in Egypt. The second section deals with Greek and Hellenistic chemistry. Here, as is fitting, Plato and Aristotle have the pride of place, the great achievements of Aristotle receiving particularly careful attention. A short note upon Archimedes's method of determining specific gravity leaves the "eureka" story unassailed in principle, but proves that the "crown" of Hiero was really a golden wreath. On the other hand, the author robs that early precursor of Mme. Curie, the alchemist Maria (possibly of the first century A.D.), of the credit of inventing the water-bath ("balneum Mariæ") and Papin of his "digester," showing that the former was known before Aristotle and the latter in the third century A.D. These two destructive articles illustrate very well Prof. von Lippmann's encyclopædic knowledge of the literature of his subject. Among the most interesting of the later articles are those on the chemical names used by Marco Polo, on J. J. Becher's observations anticipatory of Mendel and De Vries, on Jean Rey, on the word "gas," which van Helmont is declared to have adopted from the "chaos" of Paracelsus, and on E. C. Howard, the inventor of the vacuum apparatus for sugar-refining. But the author has touched no subject which he has not adorned.

Mineral and Aërated Waters. By C. Ainsworth Mitchell. Pp. xiii+227. (London: Constable and Co., Ltd., 1913.) Price 8*s*. 6*d*. net.

THE author takes us back to the beginnings of the mineral-water industry by interesting descriptions of natural mineral springs, spas, and holy wells; for it was from the first attempts to copy the actual or supposed healing virtues of such waters that the extensive manufacture of mineral waters began, developed, and expanded into the great industry of to-day. The analyses of the more famous natural waters are given in the first part of the volume, devoted to the history of the subject, and perhaps the most striking feature of this history is the changed aspect of current belief in the efficacy of such waters by the known presence of radio-active substances contained in some of them. The chemical constituents being accurately known, a natural water can be produced in the laboratory, but, as is frequently asserted, without the therapeutic action of the natural product. The author states, however, that "recently bottles of special construction, containing artificial radio-active mineral waters, have been put upon the market in Sweden."

The methods of qualitative and quantitative analysis employed by the chemist are not included, since there is nothing specially applicable to this particular industry in them. The historical account of the apparatus devised for the purpose of aërating natural water by carbon dioxide is an instructive example of the slow and gradual stages required to effect a comparatively simple process. From the first experiment of Bergmann in 1770 the invention and elaboration of apparatus for aërating and bottling has extended, and the latter half of the book is devoted to descriptions of the machines employed to-day. The commercial production of liquid carbon dioxide has simplified the process, and most ingenuity is centred upon the charging and bottling machinery and the gas-tight fastenings. The description of the machinery is somewhat superficial, and is the least effective part of a commendable work. The examination of mineral waters for bacteria and metallic contamination is of special interest in view of the various containers for such waters on the market.

Vorlesungen über allgemeine Histologie. By Prof. Alexander Gurwitsch. Pp. v+345. (Jena: Gustav Fischer, 1913.) Price 11 marks.

Prof. Gurwitsch's work is not a text-book of histology in the ordinary sense. It is arranged in the form of a series of lectures, in which the subject is dealt with not as an end, but as a means to the solution of the wider problems of biology; a good deal of space, for instance, is taken up with a discussion of the meaning of heredity. The lectures, written as they are from a critical and philosophical point of view, are full of interest, and examples are taken from every branch of the kingdom of life to illustrate the subject. The drawings of microscopic appearances which beautify the text are numerous, well selected, and well executed. W. D. H.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

Submerged Valleys and Barrier Reefs.

In a letter on "Dana's Proof of Darwin's Theory of Coral Reefs," published in Nature for April 3, Mr. Cyril Crossland points out that "land valleys which extend beneath the sea are not always proof of subsidence. Such valleys, like coral reefs, may owe their existence to different factors in different cases." He adds that certain harbours on the east coast of Africa "are the high parts of submarine fault valleys," which, although they simulate embayments produced by the general depression and partial submergence of a dissected coastal region, really result from the local depression of fault blocks, and hence cannot be taken as evidence that any coral reefs which may occur near them have been built up during a period of submergence.

There can be no two opinions on this point; but the discussion of fault-block depressions is aside from the problem involved in Dana's proof of Darwin's theory, which is concerned with valleys of erosion. To imply that an argument which involves only such valleys is vitiated because some "land valleys" are due to down-faulting or other causes is unwarranted. If "land valleys" due to faulting were called "troughs" instead of "valleys," their irrelevance would be more apparent.

Some of the harbours on the Red Sea coast, mentioned by Mr. Crossland as due to down-faulting, are regarded by Mr. John Ball as partly submerged valleys of normal erosional origin above sea-level; so he states in a letter which appeared in Nature for May 22. Which of these two opinions is the correct one may be best left to observers on the ground, as neither of the writers here cited adduces detailed evidence to support his conclusion. Mr. Crossland's remarks on the relation of certain coral reefs to abrasion I will not discuss here, because, probably on account of the brevity of his note and the lack of explanatory diagrams, his meaning is not clear to me. But his statement that "land valleys which extend beneath the sea are not always proof of subsidence" calls for comment, because it indicates a misunderstanding of the question at issue.

The embayments considered in my article on "Dana's Proof of Darwin's Theory of Coral Reefs," published in Nature for February 6, were not such as occupy down-faulted troughs, or over-deepened fiords of glacial origin, neither of which indicate subsidence of their region, but only such as occupy valleys of normal erosion; that is, valleys which have been excavated by the ordinary processes of subaërial weathering and washing, and can therefore have originated only on land above sea-level. The peculiar and essential consequence of Darwin's theory, which remained unnoticed by its author, is the invasion of the previously eroded normal valleys of a dissected and subsiding coast by the sea; and the whole point of the long-neglected confirmation of Darwin's theory lies in the evidence that Dana gave to the effect that the drowned valleys of the Pacific islands had been formed by the action of land waters above sea-level before they were drowned, and not by any other process, such as down-faulting or glacial erosion, or by marine erosion, as Darwin apparently thought. Hence, interesting as are the complications which Mr. Crossland mentions, they do not touch the question in discussion, which has to do, not with shore-line embayments of whatever origin, but with embayments of a highly specialised kind, occupying valleys of normal erosion. So far as the evidence of the Admiralty maps and of various recent observers goes, the embayments of the central islands enclosed by barrier reefs in the Pacific are practically all of this highly specialised kind; the occurrence of other kinds of embayments elsewhere is no more relevant to the case than the occurrence of upraised platforms of marine erosion.

The real point raised by Mr. Crossland's letter is the possibility of distinguishing between embayments of different origins. I cannot accept his opinion that embayments which occupy troughs produced by locally down-faulted blocks simulate embayments formed by the submergence of normally eroded valleys, unless in a very rough manner, from which no confusion should arise. Even if the two kinds of embayments do in some superficial manner simulate each other, they can be distinguished readily enough. A normally eroded main valley is joined by branch ravines and side valleys, all systematically related as parts of a valley system; they may have young, mature, or old forms, according to their stage of development. Submergence of a main valley must therefore produce an indented or branching embayment, like the "rias" of north-western Spain or the drowned rivers of Devonshire-Cornwall. A down-faulted trough must at first be bordered by escarpments of simple pattern; the escarpments will gradually be dissected by ravines and valleys, but these cannot be eroded beneath sea-level; hence the arm of the sea that takes possession of such a trough cannot have lateral branches or indentations, unless the sides of the trough as well as the trough block itself suffer depression—that is, unless regional depression takes place. Likewise, a coastal valley may be occupied and over-deepened by a glacier, and invaded by the sea after the glacier withdraws, thus producing a fiord; but a fiord can be easily distinguished from a drowned fault trough or from a ria. Evidently, then, in applying Dana's proof, it is essential to see that glacial fiords and fault troughs are not confused with normal valleys; and it still appears to me that my article of February 6 made it clear that only normal valleys were under consideration.

A few words as to terminology. Various popular terms, like "fish" and "valley," which entered our language in a pre-scientific period, have to-day two meanings; first, their original general meaning, and second, a later acquired and more precisely limited scientific meaning. "Fish" originally meant an animal living in the sea, and included whales and oysters. The latter are still known as shellfish, and a certain kind of whale is still named blackfish; but under the influence of scientific zoology whales are now classed by most persons not with fish but with mammals. So with "valley"; the original meaning of the word is simply an enclosed lowland, more or less elongated, of whatever origin, and this vague meaning is still in common use, as in naming the valley of the Wye, purely the work of normal erosion; the valley of the Ticino, greatly modified by glacial erosion; the valley of the middle Rhine, a fine example of a down-faulted trough; and the valley of California, a broad and relatively shallow down-warp. But "valley" has also been used, since the time of Hutton and Playfair, in the scientifically limited sense for forms of normal erosion under the action of rain and rivers; and when thus used it implies an origin above sea-level, as well as the systematic arrangement of certain significant features, such as slope of stream line, manner of junction of tributary and main valleys, and so on, by which the normal origin of a valley may be easily recognised. The Norwegian term "fiord" (fjord), and the Spanish term "ria," both locally used without scientific definition or implication of origin for the sea-arms that they designate, have in recent years both been given a more limited meaning in scientific geographical literature. It was only, as the context shows, in the scientific sense of a form of normal erosional origin above sea-level that the term "valley" was used in my article; and manifestly it is only to coasts which exhibit branching or indented embayments, such as were shown in the middle block of my diagram, and such as are caused by the submergence of true valleys of erosion, that Dana's proof of Darwin's theory applies.

W. M. DAVIS.

Harvard University, Cambridge, Mass., June 7.

Uniformity in Radio-active Nomenclature.

IN a letter to NATURE of June 5, Mr. W. H. Ross and Mr. H. J. Creighton point out the present want of uniformity in radio-active nomenclature, and suggest that some definite system should be adopted by all writers on this subject. Every worker in radioactivity recognises the importance of some agreement in regard to this matter. It is difficult, however, for a single individual to suggest a scheme which would be likely to gain universal support. The only international body existing at present which is in a position to deal with such a question conveniently and expeditiously is the International Radium Standards Committee. The constitution of this committee is fortunately very suitable for the consideration of this question, as it comprises about an equal number of physicists and chemists representing five nations. As president of the International Committee, I should be glad to bring the matter to the attention of the other members, and will do so if there is no objection to this proposal. E. RUTHERFORD.

Radio-activity and the Age of the Earth.

MR. HOLMES, in his interesting letter in NATURE of June 19, brings out the embarrassments in which the superabundance of radio-activity in the accessible crust of the earth and the enormous antiquities deducible therefrom have plunged physics. His explanation is that since the earth as a whole cannot be as radioactive as the crust, without liquefying, there cannot be as much radium in it as might be inferred from the samples we can take, and that its "heavy metallic core" must be "completely destitute of radium." This, however, involves the improbability that the heaviest metal of all, uranium, has not gravitated to the "metallic core," and does not explain why this core should be destitute of radio-active substances.

It may be pointed out, therefore, that the whole reasoning rests on an assumption to which alternatives might be considered. It is assumed that the dissociation of uranium has been proceeding always and everywhere at the rate we can now observe on the earth's surface. But it is possible that under the physical conditions obtaining in the interior uranium does not dissociate, or does so much more slowly. It is even possible that it has not always proceeded at this rate in the past. Radio-activity may be an acquired habit of the substances that exhibit it.

There is no scientific objection to the suggestion that the existing "laws of nature" are not immutable but "evolving," beyond the methodological inconvenience that this would greatly complicate our calculations and detract from the exactness of our predictions. But of improbabilities, as of evils, we must always choose the least. F. C. S. SCHILLER.

Corpus Christi College, Oxford, June 23.

Pianoforte Touch.

THREE variables appear to be possible in pianoforte touch, namely:—

(1) The energy of the blow of the hammer.
(2) The duration of contact of hammer with wire.
(3) The resonance of the woodwork.

Of these, (1) will be admitted by everyone; (3) should be in abeyance as much as possible, since it is brought into evidence chiefly when the key is struck too hard—beyond the capacity of the wire for harmonic response. But the mechanism of some pianos (even by first-class makers) is so resonant that a "xylophone" effect is only too easily produced. This effect evidently has its admirers, being cultivated by performers as well as ministered to by piano-makers.

(2) Is assumed by many persons; but the possibility is doubted by others, because the player cannot hold the hammer in contact with the wire. The hammer, as mentioned by Prof. Bryan, is disconnected from the key, so that at the time of striking the wire it is a projectile.

At some point in the mechanism, between the key and the hammer, is an arrangement called the "escapement," which disconnects the key from the hammer when the player's touch is so deep or firm as to cause the risk of blocking; but when his touch is shallow the escapement is scarcely brought into action.

In the upright pianos of fifty years ago the hammer was hinged on to a vertical rod called the "hopper" or "sticker," which pulled it back with a variable force, the escapement being *below*, between the hopper and the key. With a shallow touch in such an instrument it is just possible to avoid bringing the escapement into action, and thus not to hasten the return of the hammer, but the effect is decidedly difficult to produce, and the mechanism has become obsolete owing to its unsatisfactory working.

In modern uprights the hammer is more free, for the escapement is *a stage higher*, between the hammer and the hopper; a piece of tape passing from the hammer to the hopper exerts an elastic pull on the hammer, assisting gravity in causing the return of the hammer, but only when the key is released.

In the grand piano the hammer is left as independent as possible, so as to ensure rapid repetition; and I have not yet found or read of a horizontal action in which any accessory mechanism can influence the return of the hammer. Therefore in the horizontal piano (and probably in the ideal upright) the hammer at the moment of hitting the wire is an unencumbered projectile, and the variables (1) and (2) are not separable.

It should be remembered that *staccato* and *legato* effects are functions, not of the hammer, but of the damper. But after all, the most important element in a good touch is the player's ability to strike the different notes in chord with different intensities. The artist instinctively gives their relative importance to the various notes of a chord as surely as to those of a melody; and this is one of the features which distinguish him from the mere executant or the most perfect player-piano. F. J. ALLEN.

Cambridge, June 10.

A Mechanical Vacuum-Tube Regulator.

THE mechanical vacuum-tube regulator, in which the position of a movable glass sheath relatively to the kathode determines the speed of the kathode rays, mentioned in NATURE of June 19 (p. 415) as recently brought before the Cambridge Philosophical Society by Mr. R. Whiddington, is not new, Mr. J. C. M. Stanton, Mr. H. L. T. Wolff, and myself having, in 1898, devised a similar arrangement, which is described and illustrated in the discourse which I gave at the Royal Institution in that year.

We had previously shown, in a Royal Society paper read in 1897, that the speed of the kathode rays is increased by diminishing the size of the kathode itself, and what is new and interesting is Mr. Whiddington's discovery that the mechanical regulator operates by reason of the effective size of the kathode being diminished owing to the electrostatic repulsion of the rays by the negatively charged glass sheath.

A. A. CAMPBELL SWINTON.

66 Victoria Street, London, S.W., June 20.

The Crossing of Water by Ants.

IT may not be new to observers of animal life, but I have been much interested in watching the common house ant here. We have an American fly-trap: the sugar was one day covered with ants, so I placed the trap on a finger-bowl standing in a plate of water. The ants, when they came to the edge of the water, ran round the bowl until convinced there was no way across, and then calmly "took to the water," and ran across it by aid of surface tension without getting their feet wet. Having presumably been home to the nest, they returned for more sugar, crossing in the same way, and this went on regularly, a steady procession crossing the water.

JOHN C. WILLIS.

Jardim Botanico, Rio de Janeiro, June 4.

ETHNOGRAPHICAL WORKS.[1]

(1) THIS magnificent monograph of the races of Borneo, by Dr. Hose and Mr. McDougall, illustrated by an unrivalled gallery of artistic views, covering the life of the natives of that island from the swinging-cot to the grave, will be welcomed with enthusiasm by all classes of readers. The ground had indeed to some extent been prepared by the publication in 1896 of Mr. H. Ling Roth's "Natives of Sarawak and British North Borneo," which actually contained (i., 37), seventeen years before the appearance of the present work, a "List of Tribes in Borneo," specially prepared by Dr. Charles Hose.

The book before us is a singularly happy example of joint authorship. Dr. Hose, with his record of twenty-four years' service and priceless experience under the Sarawak Government, supplemented (as he tells us himself) by his travels in other parts of Borneo, the neighbouring islands of the Archipelago, and the Malay Peninsula, was, indeed, more than ordinarily fortunate in securing a collaborator whose special qualifications as reader in mental philosophy at Oxford were crowned by his experience in the field as a member of Dr. Haddon's famous expedition to the Torres Straits and Borneo in 1898. The chief cornerstone of the book is, of course, the invaluable classification (ii., ch. xxi) of the tribes of Borneo, which is supplemented by an admirable appendix on the statistics and comparative literature of the same subject by Dr. Haddon, who correlates so far as possible the ethnological work of the best Dutch authorities. The classification in the text, described (ii., 224) as resting only "on a slight basis," gives us the mature views of Dr. Hose's unequalled experience, and satisfies us that the foundations of anthropological science in Borneo have here, once for all, been "well and truly laid."

Excluding the coastwise "Malays," the authors recognise six main ethnic groups, viz., Kayans, Kenyahs, Klemantans, Muruts, the nomadic Punans, and Ibans, or Sea "Wanderers," commonly called "Sea Dayaks." But since (ii., 245) both Kenyahs and Klemantans are "sections of the aboriginal population of nomadic hunters (Sc. Punans) who have absorbed Kayan culture," these six clearly represent but four original stocks, viz., Kenyah-Klemantan-Punans, Kayans, Muruts, and Ibans; and this agrees with the statement made elsewhere that "the present population of the island is derived from four principal sources," the last three being regarded by the authors as later immigrants.

The members of the first group are identified as "Indonesians," that much-misused term which, as

[1] (1) "The Pagan Tribes of Borneo." A description of their Physical, Moral, and Intellectual Condition, with some Discussion of their Ethnic Relations. By Dr. Charles Hose and William McDougall, F.R.S. With an Appendix on the Physical Characters of the Races of Borneo, by Dr. A. C. Haddon, F.R.S. Vol. i., pp. xv+283+143 plates. Vol. ii., pp. x+374+211 plates+4 maps. (London: Macmillan and Co., Ltd., 1912.) Price 42s. net. 2 vols.

(2) "In the Shadow of the Bush." By P. Amaury Talbot. Pp. xiv+500+plates+map. (London: W. Heinemann, 1912.) Price 18s. net.

(3) "Monumental Java." By J. F. Scheltema. Pp. xviii+302+xl plates. (London: Macmillan and Co., Ltd., 1912.) Price 12s. 6d. net.

defined by the authors, means a predominantly "Caucasic" (and dolichocephalic) race modified by Mongol admixture, the latter strain supplying an element which, as the authors remark (ii., 228), has been wrongfully ignored by some writers. The second main stock is the brachycephalic "Malayan" or "Southern Mongol" element, called "proto-Malays" both by our authors and Dr. Haddon. This element is described (ii., 229) as "a blending of the Mongol stock (or of a part of the Indonesian race) with darker" proto-Dravidian stock, "of which the Sakai of the Malay Peninsula (and perhaps the Toala of Central Celebes) seem to be the surviving representatives in Malaysia." Thus the chief factors in the population are due to varying blends of two main stocks, the one Indian, the other Mongolian, these elements agreeing with those that are found, though quite differently blended, on the neighbouring mainland of Asia. Yet the negrito element, which occurs both in the Malay Peninsula and the Philippines, seems now to be in total default in Borneo, and of Melanesians, according to Dr. Haddon, there are also no traces. It should be noted that Dr. Haddon (ii., 313) regards the Punans and Kenyahs as "mainly proto-Malayan in origin," whereas the authors classify them definitely as Indonesians.

FIG. 1.—Youthful Sea Dayaks in gala dress. From "The Pagan Tribes of Borneo."

It would take many pages of NATURE to do full and adequate justice to all sections of this book. A veritable museum of Bornean ethnology, its cases contain, as in the matter of the Kayan headhunting cult (the stupid European exaggerations about which receive satisfactory castigation, i., 76), weird forms of burial, *tatu* rules, strange forms of spirit-worship and possession, and so forth, many of the most suggestive specimens of modern race-lore.

We may conclude with an item of personal interest in reference to totemism. In vol. ii. (p. 112 and footnote) Messrs. Hose and McDougall, boldly heterodox, avow and give reasons for their belief in the possibility of deriving the clan totem from that of the individual. Upon this very point Mr. Lang, in 1908, remarked to the present writer: "I am unable to conceive the reason, when everybody has his own *ngarong*, which he has not hitherto bequested, for a rule that Mary's or Jane's *ngarong* must for ever belong to her descendants. . . . Given the individual with his *rapport*, no one has shown how it became hereditary, in the female line, at a time, too, when the man's children (or the woman's) had also *their* individual *rapport*."

The writer of the words just cited *silet*, alas, *aeternumque silebit*, but the controversy continues, and it should, perhaps, in justice be conceded that the case made out by Messrs. Hose and McDougall is, so far as it goes, a strong one. It would have been interesting if they could have told us of any communities where the children were regularly named after plants or animals, or other natural objects. We must not, however, be led into a discussion on the origin of totemism, which is too large a question to discuss here, and must therefore recommend the authors' views to the attention of the advance guard of totemic experts.

(2) Mr. P. Amaury Talbot's "In the Shadow of the Bush" gives us an intensely vivid and illuminating picture of the Ekoi, a semi-Bantu people of the south-east corner of Nigeria, a region that recalls the mingled mystery and horror of—

> Enter these enchanted woods,
> Ye who dare. . . .
> Thousand eyeballs under hoods
> Have you by the hair!

Here all is blasted by the terrible blight of negro witchcraft. Indeed, the attention will doubtless be immediately riveted by the account of the Human Leopard and Alligator Societies (first revealed to most Englishmen by the writings of the late Mary Kingsley), the late (1912) activity of which recently drove the local Government to action and provoked an interchange of questions in the Imperial Parliament.

Ethnography in the widest sense, linguistics (especially on the Bantu affinities of Ekoi and on its secret signary, "Nsibidi"), folklore, native art, even archæology, all these, with much valuable natural history, go to make up a fascinating volume full of direct and irresistible appeal. The achievement is worthy of one who, besides his administrative experience, can claim to have made history in companionship with the late Boyd Alexander.

(3) The record of official ineptitude and rapine pictured in Mr. Scheltema's erudite and enlightening "Monumental Java" is almost incredible. Thus (p. 240) Mr. Scheltema, with biting sarcasm: "We are told in legendary lore of statues which flew through the air . . . dissolving into space; the statues of the Boro Budoor developed that faculty in an astonishing degree!" The climax was reached in 1897, when the late King of Siam, on his visit, was invited and allowed to remove (p. 244) from that "superb temple, whose soul is the soul of Java," eight cartloads of irreplaceable statuary! Such vandalism was in defiance of the protests of Dutch scholars, whose noble efforts, like those of Raffles (pp. 55, 76, 238), are freely acknowledged. The work clearly illustrates the real significance of "Boro Budoor" as a sculptured record of the history of Buddhism, the type being that of the Mahayanistic or northern Church (pp. 222,235), not the Hinayanistic or southern type, as was claimed for his Church by the late royal visitor.

W. W. Skeat.

Fig. 2.—Reliefs of the Boro Budoor. From "Monumental Java."

THE BRILLIANT FIREBALLS OF JUNE 14.

On June 14 at 8h. 4m., when the sun was shining, and at 10h. 0m., in the bright moonlight, very large meteors made their appearance. The former gave a startling flash, even in the daylight, and the latter was strikingly brighter than the moon, according to the testimony of several observers.

Neither of the fireballs passed over any part of England, though witnessed by many persons from the eastern and south-western counties respectively. The earlier fireball at 8h. 4m. appeared over the sea off the eastern coast near Harwich and Aldborough, and it had numerous spectators in Kent, Essex, Suffolk, and Norfolk. The other passed above the sea far west of Land's End, and had a long and horizontal flight of 490 miles directed from south-east to north-west from over L'Orient, about sixty miles south-east of Brest in France, to eighty miles west of Dunmore Head in the south-west of Ireland.

The following are the resulting heights, velocities, &c., of the two fireballs, which have been computed from a considerable number of descriptions forwarded to me from many parts of the country :—

1913, *June* 14.

G.M.T. ...	...	8h. 4m. ...	10h. 0m.
Magnitude	=	much brighter than ☽	brighter than ☽
Height at first	=	77 miles	54 miles
,, end	=	29 ,,	54 ,,
Luminous course	=	58 ,,	490 ,,
Velocity per second	=	22 ,,	26 ,,
Radiant point	=	$263^\circ + 64^\circ$	$282^\circ - 23^\circ$
Name of meteor	=	ζ Draconid	ψ Sagittarid

Long as the flight of 490 miles undoubtedly is for the second fireball, it is probably much less than the actual course. When the object was last seen from Ireland it was really rising in the air, and was still burning strongly when low apparent altitude carried it behind either trees or buildings, as viewed by several observers. I suppose it is possible for a meteor to escape out of the atmosphere when its flight is horizontal and its material capable of withstanding absolute disintegration. We want more observations from the west of Ireland.

The daylight fireball at 8h. 4m. left a streak for about three minutes, and several of the observers state that a noise like thunder followed its disruption in two or three minutes. One person at Watford avers that he is certain the meteor was not more than twenty yards distant from where he stood, for he witnessed the object descend in front of some trees.

W. F. DENNING.

THE STATE AND MEDICAL RESEARCH.

A COMMITTEE with executive functions, to be known as the Medical Research Committee, has been appointed for the purpose of dealing with the money made available for research under the Insurance Act. The Committee is constituted as follows :—

The Right Hon. Lord Moulton of Bank, F.R.S. (chairman).
Dr. C. Addison, M.P.
Mr. Waldorf Astor, M.P.
Sir T. Clifford Allbutt, K.C.B., F.R.S., Regius professor of physic, University of Cambridge.
Mr. C. J. Bond, senior honorary surgeon, Leicester Infirmary.
Dr. W. Bulloch, F.R.S., bacteriologist to the London Hospital, and professor of bacteriology in the University of London.
Prof. M. Hay, professor of forensic medicine and public health, Aberdeen University.
Dr. F. Gowland Hopkins, F.R.S., reader in chemical physiology in the University of Cambridge.
Sir W. B. Leishman, F.R.S., professor of pathology, Royal Army Medical College.

The appointment of the Committee is the outcome of the final report of the Departmental Committee on Tuberculosis, which was summarised in an article in NATURE on April 24 (vol. xci., p. 191). In this report the Committee recommended the appointment of an Advisory Council and an Executive Committee, and both have now been constituted. The Advisory Council is to make suggestions, and to submit the Executive Committee's budget to the Government, and to advise the Executive Committee.

The Executive Committee is to frame a budget to be considered with the Advisory Council before being submitted to the Government; to determine the scheme of research work; to make periodic reports, and generally to organise and supervise research work.

The Departmental Committee suggested that the work of research could be carried out advantageously on the following, among other, lines :—

(*a*) A central bureau should be established and should be the headquarters of the Advisory Council and Executive Committee. The central bureau should have a statistical and sociological department, in the work of which should be included the coordination and correlation of results. With regard to statistical investigations, every effort should be made to utilise, where possible, and cooperate with the statistical departments of the different Government departments. Statistics should be so collected and framed as to be comparable with the existing statistics of mortality. There should also be a library and publishing department. The central bureau should be under the immediate control of the Executive Committee.

(*b*) Clinical, pathological, bacteriological, chemical, and other scientific researches should be carried out by competent investigators employed by the Executive Committee in institutions approved by it.

(*c*) When the Government, on the recommendation of the Executive Committee, and after consulting the Advisory Council, deems such arrangements desirable, researches of the same nature as those referred to in the preceding paragraph should be carried out in an institution or institutions (including laboratories and hospital wards) which should be under the immediate control of the Executive Committee to the extent and for the purpose in question.

(*d*) Money should be available in order that special inquiries—*e.g.* of a statistical and sociological nature—should be carried out by the Executive Committee if necessary, independently of any particular institution.

(*e*) The question whether a sum of money, not exceeding 1000*l.* per annum, should be available as a prize or prizes for the best original research work done should be considered. The money should only be awarded if the discovery is of sufficient importance and utility.

As regards research workers the Departmental Committee recommended that some workers of proved and exceptional ability should be enabled to devote their whole time to research work, and should be given a definite and adequate salary, and be entitled to a pension. The Committee also considered that efforts should be made to retain for research work young and talented investigators who would otherwise tend to drift into other lines.

The Departmental Committee computed that the income for the purposes of research under the Insurance Act will amount to about 57,000*l.* a year, and the Medical Research Committee will be called upon to draw up a general plan of research to be entered upon at once, and to be carried out year by year. But before the Minister responsible for national health insurance consents to the adoption of the plans of the Research Committee they will be subjected to examination and criticism by the Advisory Council, which is a large and representative body including most of the members of the Departmental Committee. It was appointed by Mr. Lloyd George after receiving suggestions for suitable names from each of the universities of the United Kingdom, from the Royal Colleges of Physicians and of Surgeons, from the Royal Society, and from other public bodies interested in the question. It includes medical representatives of the four National Health Insurance Commissions, and the other Government departments concerned in medical work.

SIR JONATHAN HUTCHINSON, F.R.S.

WHEN the history of modern medicine comes to be written it is certain that Sir Jonathan Hutchinson, who died in his eighty-fifth year at Haslemere on June 23, will occupy a more prominent position than that usually assigned to him by his contemporaries. He had the misfortune to be at work when Pasteur and Lister opened up new, attractive, and practical fields of research, carrying with them all the eager intellects of a younger generation, and leaving the subject of this notice to explore the inexhaustible fields of clinical medicine. From the year 1844, when he was apprenticed to Dr. Caleb Williams, of York, at the age of sixteen, until the day of his death, within a month of finishing his eighty-fifth year, he never ceased to study the manifestations of health and disease, and to place his observations and inferences on record.

Sir Jonathan Hutchinson was an inductive philosopher who patiently and accurately collected facts to provide a sure basis for the principles of scientific medicine. The monument he leaves behind him is seen in the volumes of the "Archives of Surgery," "Atlas of Illustrations of Clinical Surgery," and the hundreds of clinical records which are to be found in medical literature of the last fifty years. He leaves behind him no brilliant discovery to fix his name in the public memory, and yet it may be claimed for him that he did more than any man of his time to solidify the foundations of the surgeon's art.

He was a self-made surgeon, neither the follower nor the leader of any school. It is true that after coming to London in 1850, at the age of twenty-two, he came under the influence of Lawrence and of Paget at St. Bartholomew's Hospital for a few months, but the spirit which dominated him when he ultimately settled in London was the quiet inquiring and observing mood which he acquired in the seclusion of his Quaker home in Selby. Before he was in his thirtieth year he was on the staff of the leading eye hospital (Moorfields), Blackfriars Hospital for Diseases of the Skin, the Metropolitan and the London Hospitals, where he had to deal with all the problems of general surgery.

With those great and varied clinical fields at his disposal he was able, in less than ten years from the time he settled in London, to produce convincing proof that a host of conditions which were regarded as separate diseases were really the remote manifestations of syphilis, and amenable to specific remedies.

The varied and puzzling diseases to which the skin was liable had a special attraction for Sir Jonathan Hutchinson, and it was at an early stage of his career that he began a systematic investigation of the cause and nature of leprosy. In 1859 he came to the conclusion that it was due to eating imperfectly preserved fish, and that the disease was therefore non-contagious and preventable. Fifty years later found him still searching in various parts of the earth for evidence to support his original contention.

The persistency which he applied to the study of leprosy he gave to all the various lines of research he took up. He was a student of growth; he never ceased recording facts and cases which were likely to reveal the principles which regulate the growth and development of the animal body. His lectures at the Royal College of Surgeons in 1881 on the pedigree of disease are happy illustrations of the methods by which he sought to advance this kind of knowledge. He was a surgeon who made a reputation not by the use of the operating knife, but by the application of his intellect to the understanding and cure of disease. He operated with success; he introduced new procedures, but he recognised that recourse to operation was necessitated by the imperfections of the healer's art.

He was an educationist, believing that all teaching should be objective. He did much as chairman of the Museum Committee and as president of the College of Surgeons for the great museum founded by John Hunter; he established and furnished three museums in the Polyclinic (Medical Graduates' College) in Chenies Street, in his native town of Selby, and in Haslemere, where he latterly made his home.

NOTES.

WE heartily congratulate Dr. A. F. R. Wollaston on his return from a successful visit to the Ingkipulu Mountains (Nassau range), Netherlands New Guinea. Last year Dr. Wollaston gave an account of the unlucky attempt of the British Ornithologists' Union Expedition in "Pygmies and Papuans," and quite recently Capt. C. G. Rawling has published another book on the same expedition, "The Land of the New Guinea Pygmies." On the present occasion Mr. C. B. Kloss, curator of the Kuala Lumpur Museum, accompanied Dr. Wollaston, and, in addition to an engineer and five native collectors, they took with them seventy-five "Dyaks," and a large escort was provided by the Netherlands Government. Four and a half months were occupied in reaching the mountains from the coast. The geographical results cannot be worked out for some time. Extensive zoological collections were made which comprise many new species; among them is a very beautiful bird of paradise which may be new. A hitherto unknown tribe of a rather short people of Papuan type were met with at an elevation of some 4000–6000 ft. Despite the very cold nights they wear no clothing. They are mainly collectors and hunters, but also grow sweet-potatoes, tobacco, and sugar-cane. They carry bows and arrows and shoulder-bags containing apparatus for making fire, tobacco, knives, spoons, and other small belongings in true Papuan style. Their knives are made of a hard, slaty stone that can be brought to so keen an edge that bamboos can be cut with them. The people are said to be extremely attractive, most friendly, and in some respects more intelligent than the people on the coast. We await with interest Dr. Wollaston's account of his adventurous journeyings, and sympathise with him in the loss of a considerable proportion of his notes due to the capsizing of a canoe.

A shameful outrage has just been perpetrated at the Gatty Marine Laboratory of St. Andrews, the gift of Dr. C. H. Gatty to the University. The laboratory has always been freely open to scientific workers of both sexes without distinction of religion or political feeling, and might therefore have been expected to be immune from attack; yet it has been fired, apparently by militant suffragettes, who have thus destroyed much of the work of members of their own sex. Several large original coloured drawings—all the exquisite work of a lady, the late Mrs. Albert Günther—have been irretrievably ruined by the fire. Fortunately most of the fine original drawings of marine animals made by Mrs. Günther were in the corridor and other rooms, away from the main workroom, and so securely framed that though begrimed with soot, they are practically as before. The coloured and uncoloured plates for the next Ray Society work had been lying for four or five months on a table in an adjoining room, and they also escaped. It appears that on Saturday, June 21, the incendiaries effected an entry by smashing one of the windows on the south side of the laboratory, after plastering it with soft soap and paper. Explosives and combustibles were placed in one of the cubicles and lit, and the perpetrators of the outrage escaped through a window. The print of a small shoe, and suffragette literature stuck between the wall and a rain-pipe, were the only traces left. Fortunately the fire was seen by a fisherman, who gave the alarm, but the large workroom was wrecked and the roof ruined before the firemen obtained control of the fire. We sympathise with the director, Prof. McIntosh, who has always done so much to help on the scientific education of women at the University of St. Andrews.

The Gustave Canet lecture of the Junior Institution of Engineers will be delivered by Dr. Dugald Clerk, F.R.S., on the working fluid of internal-combustion engines, on Monday evening, June 30, at the Institution of Electrical Engineers, Victoria Embankment, W.C. The chair will be taken by the president, Sir A. Trevor Dawson, R.N.

The death is announced, in his thirty-fourth year, of Prof. C. C. Poindexter, one of the most promising of the younger negro educational leaders in America. After graduating at Ohio State University in 1903, he spent two years as a graduate student at Cornell. Four years ago he went to Fisk University, Nashville, as assistant-professor of biology, from which post he was promoted, after two years' service, to a full professorship.

The annual exhibition of antiquities discovered during excavations at Meroë, Sudan, carried out in connection with the Institute of Archæology, University of Liverpool, will be held in the rooms of the Society of Antiquaries, Burlington House, Piccadilly, W., from Tuesday, July 8, to Friday, July 18, inclusive. The exhibits will include decorated pottery vases, objects of faience and of bronze, intaglio-rings, &c., plans and photographs, and copies of frescoes and sketches in colour.

It was announced in the issue of Nature for May 29 (p. 338) that of the 100,000*l.* bequeathed by the late Sir J. Wernher, Bart., for charitable and educational purposes, 5000*l.* was a grant to the Institution of Mining and Metallurgy. At a recent meeting of the institution, the president, Mr. Bedford McNeill, announced that Lady Wernher had added a second 5000*l.*, making a total of 10,000*l.* The only condition attached is that Lady Wernher desires that the principal sum shall remain intact as an aid in permanently strengthening the institution. The income is to be devoted to the ordinary purposes of the institution.

The *Japan Chronicle* reports the death, at St. Petersburg, on May 27, at fifty-one years of age, of Dr. Shogoro Tsuboi, professor of anthropology at the Tokyo Imperial University. The deceased, who had been attending the meeting of the International Association of Academies at the Russian capital on behalf of the Japanese Academy, was regarded as the greatest authority on his subject in Japan. In 1884 he established the Tokyo Anthropological Society, and started a vernacular magazine which has done much to further the development of the science in Japan. Dr. Tsuboi was an honorary member of our Royal Anthropological Society, and a corresponding member of the Berlin and Paris Anthropological Societies.

The sixth of the series of International Fishery Congresses, established at Paris in 1900, is appointed to be held at Ostend on August 18–20, under the patronage of his Majesty the King of the Belgians. The Board of Agriculture and Fisheries has arranged to be represented officially at the congress, and has also sent a fisheries exhibit to the International Exhibition now being held in Ghent, of which the section devoted to fisheries will be closely associated with the congress. It is hoped that British fishery interests will be fully represented at the congress, and all interested in fish and fishing and the various related industries, and in the studies connected therewith, are invited to take part in the proceedings, by the reading of papers and otherwise. The subscription for members, giving the right to take part in the discussions and excursions, and to receive the publications of the congress, has been fixed at 10 francs (8*s.* 4*d.*). Full particulars can be obtained from the general secretary to the congress, Kursaal, Ostend, Belgium, direct, or through the Board of Agriculture and Fisheries, 4 Whitehall Place, London, S.W.

The annual congress of the Royal Sanitary Institute is to be held this year at Exeter on July 7–12, under the presidency of Earl Fortescue, who will deliver the inaugural address. A popular lecture on imported foods from a Colonial point of view will be given by Sir John McCall, Agent-General for Tasmania. Sir William Collins will lecture to the congress on "The Chadwick School of Thought: An Appeal from the New Sanitarians to the Old." The work of the congress will be divided into four sections, which, with their presidents, will be:—Sanitary Science and Preventive Medicine, Mr. A. Wynter Blyth; Engineering and Architecture, Mr. H. P. Boulnois; Domestic Hygiene, Mrs. Michelmore, Mayoress of Exeter; Hygiene of Infancy and Child Study, Mr. E. J. Domville. During the meetings the following associations will hold conferences:—Municipal representatives, medical officers of health, engineers and surveyors to county and sanitary authorities, veterinary and sanitary inspectors.

The report of the council of the Concrete Institute, recently presented at the annual general meeting, shows a gratifying increase in membership, and an increasing interest in everything pertaining to the theory and practice of construction in concrete, plain and reinforced. The science committee has under consideration a system of standard notation for calculations in structural engineering, and also, in conjunction with the reinforced concrete practice standing committee, a proposed standard specification for reinforced concrete work. Among other work in hand the committee is investigating the effect of oils and fats on concrete, and the adhesion of and friction between concrete and steel. The practice standing committee of the institute has drafted reports on the surface treatment of concrete, and cracks in concrete, which were submitted for discussion at a general meeting, while the committee on tests has many matters under investigation, including the collection of data regarding the moduli of elasticity of concrete for stresses within working limits. The activity of the institute is a healthy sign of the attention which English engineers are giving to the vast possibilities of reinforced concrete, already more fully developed and realised in some other countries.

Mr. Stefánsson's expedition has started for the Beaufort Sea, and will be followed with intense interest by all interested in polar exploration. It means to attack the last great problem of the Arctic. It has been maintained by certain authorities of the highest standing that there is an extensive land to be discovered in the Beaufort Sea quadrant, but the question has long been disputed. Mr. Stefánsson hopes to settle it, and is giving himself nearly four years in which to do so. There will be much occasion for scientific research, and these are days of large scientific staffs on polar expeditions. The staff of the present expedition numbers no fewer than fifteen, and if land is discovered and the expedition is in proper state to take advantage of the discovery, there will be unsurpassed opportunities for scientific work. So far as it is possible to judge in advance, the leader of the expedition appears to expect moderately favourable conditions for the voyage northward from the North American Arctic coast. With easterly winds a clear sea is practically assured; westerlies will pack the ice. It is believed that a condition of balance between these two extremes is to be expected, and the resulting conditions should not offer serious obstacles to a well-tried vessel under so well experienced a commander as Captain Bartlett.

In the House of Commons on June 18 Mr. Cathcart Wason asked what percentage of men have failed with the colour-vision tests introduced on April 1, and how this percentage compares with that of former years; and how many men have passed with the wool test and failed with the lantern test, and *vice versâ*? The Parliamentary Secretary to the Board of Trade (Mr. Robertson) replied:—"The total number of men examined in colour vision from April 1 to May 31 was 1689, and of these 105, or 6·22 per cent., failed. Of the 105 failures, fifty-five failed in both the wool test and lantern test, and fifty in the lantern test only. None failed in the wool test only. I regret that it is not possible to give corresponding figures for previous years, since the statistics available for previous years relate to examinations, and not to individuals. I may mention, however, that in 1912, out of 7326 examinations in colour vision, 163, or 2·22 per cent., resulted in failure. The figures for the two periods are not comparable, both because of the difference of basis and because the Board of Trade have reason to believe that the number of candidates examined in the last two months includes an abnormal proportion of persons who have never been examined before, among whom, naturally, the percentage of rejections is disproportionately high."

The committee of the twelfth International Geological Congress has now issued the third and final general circular. Applications to join excursions have been received more rapidly than was anticipated, therefore intending participants should delay no longer. Delegates appointed by universities, &c., are reminded that their application for membership should be sent in at once. The monograph on coal resources will be issued in three volumes (not two) and folio atlas—price, to members, 20 dollars, if ordered from Morang and Co., Toronto, before August 15. Changes are announced in several excursion programmes. Excursion A9 will start from Kingston at the foot of Lake Ontario. The visit to the Dinosaurian bone beds near Munson, Ex. C1, may not be possible, but those who specially desire to visit the deposits should advise the secretary. The Sudbury ore region will be visited on Ex. C1, in order that participants in excursions C1 and C2 may meet in Victoria, B.C., on August 26. Special attention is directed to Ex. C5 on account of its many attractions, including a "show" by native Indians on Grand Manitoulin Island. Ex. C8, Juneau-Yakutat section, will afford a unique opportunity for studying active glacial phenomena. Particulars are given of reductions in railway fares in Canada and the United States, and a list of hotels with their charges is provided.

The Chemical Industry and Engineering Exhibition at the Agricultural Hall, which was opened by Lord Desborough last week, is an interesting and successful development of a similar exhibition held two years ago. Its essential aim is to give chemical manufacturers an opportunity of inspecting the most recent forms of machinery and appliances rather than to display the actual products of chemical manufacture, although a number of the latter, of a more special character, are included. The bulk of the floor-space is accordingly allotted to apparatus and machinery, of which a large proportion is concerned with the transport and treatment of the products dealt with in chemical industries. Acid-resisting materials of so-called "passive" iron ("Ironac" and "Tantiron"), and acid-proof stoneware suitable for pipes, pumps, valves, taps, the cascade concentration of acids, &c., are prominent in this connection, together with a number of new forms of air-compressors, boiler-furnaces, and vacuum drying apparatus. Safety appliances for use in works are also well represented. These include safety-helmets, face-masks, respirators, &c., and a variety of appliances for life-saving and first-aid in case of accidents. The exhibits of chemical products comprise a well-selected collection of mercurials, bismuth compounds, and other pharmaceutical preparations, an exhibit designed to show the progressive stages in the manufacture of coal-tar colours from the raw materials to the finished dyestuffs, and such varied products as china clay, hydrogen peroxide preparations, and materials for the generation of acetylene. Good exhibits of laboratory apparatus are contributed by a number of well-known firms, and an exceptionally interesting collection of old glass apparatus which had been in actual use by Brandt, Hennell, and Warington has been loaned by the Society of Apothecaries. Mr. Walter F. Reid has acted as president of the exhibition, Mr. Thos. Tyrer as chairman of the advisory council, and Mr. F. W. Bridges as organising manager.

The *Daily Malta Chronicle* of May 31 reports a lecture delivered by Mr. Francesco Calleja on the early culture of the island. He laid stress on the importance of Phœnician influence, and quoted a number of words to prove that the Greek language was largely indebted to the Semitic tongues. These are positions which many modern archæologists decline to accept. For instance, Mr. D. G. Hogarth is inclined to regard the Phœnicians as mere huckstering traders, who followed sea-ways long before opened by others; and Dr. Farnell shows that Babylonia exercised practically no influence upon Greek cults and beliefs. On the philological side, until the Minoan inscriptions collected by Sir A. Evans are interpreted, it is premature to postulate the origin of the Ægean languages; and when the new material is available it will probably be found that Phœnician influence is much less important than the lecturer is inclined to believe.

Naturen for May contains an obituary notice, with a portrait, of Vilhelm Ferdinand Johan Storm, late conservator of the zoological collections of the Klg. Norske Videnskapsselskaps, who died on May 19 of the present year. Dr. Storm, who was born on September 28, 1835, took an active part in the affairs of the museum for more than fifty-seven years.

As a supplement to the second edition of his "Herpetologia Europæa" (Jena, G. Fischer), of which a notice appeared in Nature at the close of 1912, Dr. E. Schreiber has published a German translation of the Latin diagnoses of the various genera and species of reptiles and amphibians given in the original work.

According to the June number of *The Museums Journal*, the executive committee of the Museums Association is endeavouring to enlist the services of members of that body possessing expert knowledge of particular subjects—both in science and art—for the purpose of naming specimens that may be submitted to them by members and associates. Several gentlemen have already consented to undertake these duties, and it is proposed, if the scheme is well taken up, to publish lists of the names of the experts in *The Museums Journal*.

The very remarkable success that has attended the appointment of personal guides at the British Museum and its Natural History branch in Cromwell Road induced Lord Sudeley to inquire in the House of Lords of his Majesty's Government on April 29 whether arrangements could not be made for a similar system of popular instruction in other museums and institutions in the metropolis. The motion was supported, on behalf of the Education Committee of the London County Council, by Lord Greville, and was also favourably received by other speakers. It was, however, pointed out that there were certain difficulties in the case of the National Gallery on account of students' days, and in the Wallace Collection owing to the limited amount of standing room.

In the recently published volume of the Journal of the Royal Agricultural Society for 1912, Mr. A. D. Hall discusses the value of soil analyses to the farmer. He shows the anomalous results often obtained by a chemical examination of the soil, and deals at greater length with the importance of a better knowledge of the physical conditions in the soil. Although chemical methods may indicate certain manurial requirements of any given soil, a more trustworthy pronouncement as to its suitability or otherwise for the growth of particular crops can only be made after a soil survey.

A comprehensive survey of the conditions of the date-sugar industry in Bengal and an account of its chemistry and agriculture are contributed by Messrs. H. E. Annett, G. K. Lele, and Bhailal M. Amin to the Memoirs of the Department of Agriculture in India (vol. ii., No. 6, 1913). Covering as it does such a wide range of questions, and being to a large extent technical in character, it is not possible to do justice here to the greater part of the paper. Much interest, however, attaches to the suggestions for future improvements, among which may be mentioned the introduction of the Palmyra palm, so that the production of sugar by this and the date palm would extend over the whole year. In this way the erection of large central factories might be rendered possible. Consideration of the amounts of sugar obtainable from various sugar-yielding plants shows that greater quantities are to be expected from the date palm than from sugar cane in this district, and that the average yield of the former per tree is about seven times that of the sugar maple. Greater output of sugar and greater purity of product would also accrue from the disinfection of the tapped surface and of the collecting vessels by means of formalin.

THE whole of vol. xxii., part i., of the Memoirs of the Indian Meteorological Department is devoted to tables containing monthly and annual rainfall normals at all stations maintained by the Imperial and provincial Governments where records for at least five years are available. There is no discussion attached to this very valuable mass of materials, but the number of years over which the data extend has been given for each station, in order that an estimate may be formed of the trustworthiness of the results. As might be expected from other publications of the department, some of the figures are very remarkable. Among the average annual amounts may be mentioned:—Cherrapunji (Assam), 426 in.; Málkompeth (Satara, Bombay), 274·8 in.; Launglon (Burma), 234·3 in.; Rújanpur (Punjab), 3·7 in.; Rohri (Sukkur, Bombay), 3·1 in.; Jhatput (Baluchistan), 3·0 in. At "stations outside the Indian land area" still smaller values are quoted: 2·7 in. at Aden, 2·5 in. at Bahrein (Persia) and at Perim (Asiatic Turkey).

THE October, 1912, number of the *Sitzungsberichte* of the Vienna Academy of Sciences contains a short paper by Dr. W. Altberg, of Odessa, on the use of the resistance offered by a small sphere to the passage of a current of gas past it as a measure of the velocity of the gas. He used a steel sphere 0·6 cm. diameter, suspended by a metal filament 0·0025 cm. diameter, 75 cm. long, in the centre of an air duct through which a stream of air of known velocity could be passed. The deflection of the suspension from the vertical was measured by means of a microscope reading to 0·001 cm. The author finds that the arrangement is easily set up, adjusts itself almost instantaneously to changes of velocity, and allows velocities from 70 to 270 cm. per second to be determined with accuracy by means of the relation shown by Becker to hold for lower velocities, *i.e.* the resistance offered by the sphere is the sum of two terms, the first representing Stokes's law—resistance proportional to the radius of the sphere, the velocity and viscosity of the medium—the second representing Newton's law—resistance proportional to the square of the radius, the density and the square of the velocity of the medium.

THE *Verhandlungen* of the German Physical Society for April 30 contain a preliminary account of the measurements made by Dr. R. Reiger, of the University of Erlangen, on the effect of introducing exploring electrodes of various kinds into the positive column of the discharge through a vacuum tube. The change in appearance of the discharge was studied by photography, and the effect on the total fall of potential down the tube was measured. As a result the following conclusions are drawn:—In the immediate neighbourhood of the exploring electrode free electric charges are produced, and the total fall of potential is increased by an amount which increases with the diameter of the electrode and with the gas pressure in the tube. The material of the electrode and whether it is covered with glass or not make little difference for small electrodes, but for those of large diameter metals produce greater disturbances than insulators. On both anode and kathode sides of the electrode there are large falls of potential, that on the anode side being the greater. This produces serious errors when observations with double electrodes near together are made. In all cases it is advisable to use as thin exploring electrodes as possible.

WE have received an illustrated pamphlet of seventy pages, by Herr Walther Dix ("Das selbstgefertigte Lichtbild," Quelle and Meyer, Leipzig, price 1 mark), which seems to indicate that even in Germany it is desirable to urge the advantages of photography and its applications in connection with the teaching and the study of chemistry and physics. The author divides his subject into sections, and gives examples of the various uses of photography, after referring shortly to methods of making lantern-slides and paper prints. He says that photographs can well illustrate the details of various pieces or series of apparatus and the methods of using them; the methods of experimental work; the arrangement of important technical installations, if possible, by way of preparation for a visit to the works; the latest progress in connection with recent discoveries that the student deals with in his course of study; and the graphic representation of various matters, as by curves, which, by showing clearly the points to be demonstrated, will make them more easily remembered. The examples given are taken from many different sources and well illustrated.

A REMARKABLE advance in the preparation of "conductivity water" is described by Mr. R. Bourdillon in the Transactions of the Chemical Society. In the case of one sample of water, which was stored in a vacuous vessel during five years in contact with platinum electrodes, the conductivity was reduced by Kohlrausch some years ago to 0·04 gemmho; but when the water is to be used in contact with air it has been regarded as a high standard to attain to a conductivity as low as 1 gemmho in ordinary laboratory practice. The production by Bousfield of unlimited quantities of "gemmho water" by continuous fractional distillation of tap-water satisfied this requirement admirably. A further substantial improvement was subsequently effected by fractionally distilling the product under reduced pressure. In Mr. Bourdillon's apparatus the fractionation is intermittent and not continuous, but by passing purified air through the steam as it condenses a large middle-fraction amounting to 6 or 7 litres can be collected with a conductivity of the order of 0·1 gemmho. Such highly purified water cannot be used in contact with air, but in an enclosed vessel (protected by a current of purified air whenever it is opened) the rise of conductivity is only 0·004 gemmho per hour in contact with clean electrodes, or 0·01 gemmho in contact with electrodes that have recently been used for dilute salt-solutions. The value of this new development in measuring the conductivity of very dilute solutions is too obvious to require further emphasis.

THE second number has reached us of a new periodical, *Zeitschrift für Betonbau*, dedicated to the science of construction in reinforced concrete; it contains descriptions of various works carried out in this material, besides theoretical investigations from various engineers. The most novel feature of this number is a description of a swimming bath 25 metres long and 12 metres wide, containing 510 tons of water. This is supported on three points on the top of low piers, and is housed in a large building, the construction of which is described. A large bridge near Pressburg, with one span of 30 metres and another of 18·40, is described, and the computations of bending moments and reactions leading to the determination of the necessary reinforcement are set out very fully. The character of this paper bears ample testimony to the thorough manner in which Austrian and German engineers are taking up the designs of structures in this material.

Engineering for June 20 contains an illustrated account of the Hamburg-Amerika liner *Imperator*. This vessel left the mouth of the Elbe on Wednesday, June 11, for her first regular voyage. Her dimensions are approximately 50,000 tons register, 880 ft. in length, 98 ft. in beam, and 63 ft. in depth from main deck to keel. The depth from the upper boat-deck to keel is 101 ft. 8 in. The *Vaterland* was launched recently for the same company, and a third sister vessel is on the stocks; these vessels will be only slightly greater than the *Imperator*. The horse-power of the latter is 62,000, derived from Parsons turbines, and the speed is 22·5 knots. The vessel is equipped with eighty-three boats, sufficient for 5500 people, *i.e.* 300 more than she will carry, counting both passengers and crew. The boat-lowering gear is very complete; there is one electric motor on the boat-deck for every three boats, and there are special arrangements for maintaining horizontal the boat while being lowered. In addition to the commodore, the ship carries four captains, who have commanded large steamers successfully, and one of these will be always on watch, while the fourth takes general control of the crew.

THE Cambridge University Press has arranged for the issue of a series of volumes under the general title of "The Cambridge Psychological Library," to be edited by Dr. C. S. Myers, University lecturer in experimental psychology and director of the psychological laboratory. Among the volumes already arranged are:—"Psychology," Prof. James Ward; "The Nervous System," Prof. C. S. Sherrington, F.R.S.; "The Structure of the Nervous System and the Sense Organs," Prof. G. Elliott Smith, F.R.S.; "Psychology in Relation to Theory of Knowledge," Prof. G. F. Stout; "Mental Measurement," Dr. W. Brown; and "Collective Psychology," Mr. W. McDougall, F.R.S.

MESSRS. JOHN WHELDON AND CO. have just issued an ornithological catalogue containing titles and other particulars of more than 1500 books and papers, and including selections from the libraries of several eminent ornithologists.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR JULY:—

July 1. 15h. 26m. Saturn in conjunction with the Moon (Saturn 6° 30′ S.).
3. 16h. 0m. Venus at greatest elongation west of the Sun.
5. 3h. 0m. Jupiter at opposition to the Sun.
,, 13h. 39m. Mercury in conjunction with the Moon (Mercury 3° 49′ S.).
7. 3h. 0m. Mercury at greatest elongation east.
16. 15h. 29m. Jupiter in conjunction with the Moon (Jupiter 4° 47′ N.).
18. 13h. 0m. Neptune in conjunction with the Sun.
,, 13h. 49m. Uranus in conjunction with the Moon (Uranus 3° 24′ N.).
20. 6h. 0m. Mercury stationary.
21. 12h. 52m. Venus in conjunction with Saturn (Venus 1° 18′ S.).
28. 3h. 12m. Mars in conjunction with the Moon (Mars 5° 41′ S.).
,, 20h. 0m. Uranus at opposition to the Sun.
29. 6h. 12m. Saturn in conjunction with the Moon (Saturn 6° 42′ S.).
,, 19h. 30m. Venus in conjunction with the Moon (Venus 7° 40′ S.).

MINOR PLANETS.—The April number (vol. ix., No. 9) of *The South African Journal of Science* contains an article by Mr. Robert T. A. Innes, entitled "The Minor Planet MT. 1911: and on Minor Planets in General." The Union Observatory at Johannesburg devotes a considerable portion of its time to these small bodies, and the work it does is shown in relation to the minor planet problem in general. This article will be found of particular interest to those whose astronomical work lies in other directions, for Mr. Innes writes generally on the subject of these bodies, and particularly of MT. 1911. To mention one or two points of prominent interest, he states that in 1893 no minor planet would be given a permanent number until five observations were available, but to-day such a number is not allotted until observations spread over six weeks are available, and a satisfactory orbit is computed. Reference is made to Eros, to the nearly simultaneous publication of Sir David Gill's result of the solar parallax determination from observations of the minor planets Victoria, Iris, and Sappho, the value he obtained being 8·802″±0·005″, and to Hinks's value of 8·806″±0·004″ from his fine Eros work. Dr. Metcalf's method of minor planet search, that of guiding the telescope so that the plate remains approximately at rest with regard to the usual motion of the minor planet while the stars trail, is mentioned, and numerous other important items, such as the different groups of minor planets, the arrangements for organised effort, the discovery of Palisa's MT. 1911, and its subsequent rediscovery.

CORDOBA CATALOGUE OF 5791 STARS.—Dr. C. D. Perrine, in the twentieth volume of the Results of the

National Argentine Observatory in Cordoba, presents a catalogue of 5791 stars. The work is the outcome of 28,718 observations made with the 5-in. Repsold meridian circle during the six years 1885–90. The observations are of a general nature over the southern sky, and form a continuation of the general catalogue. Auwers's list of 303 fundamental stars was observed in 1889 by Prof. Updegraff, and the results are included in this catalogue. There is also included a list of sixty-three comparison stars for the minor planet Victoria, observed in 1889 by Prof. Updegraff, and this is given separately, in addition to being included in the regular catalogue. There was no unusual change or condition of the meridian circle during the period mentioned, so far as is known, and the reductions were made in precisely the same manner and with the same system of constants as in the general catalogue. The catalogue also includes the results of a comparison with Boss's Preliminary General Catalogue of the stars common to both.

The Milky Way and the Distribution of Stars with Peculiar Spectra.—The distribution with reference to the galaxy of the many stars having peculiar spectra classed by the late Mrs. Fleming has been analysed by Mr. T. E. Espin, and the results appear in the March-April number of the Journal of the Royal Astronomical Society. The distribution evidence suggests that the order A, F, G, K, M of the Harvard classification of stellar spectra requires rearranging thus, A, G, M, K, F. The author makes some interesting speculations on the structure of the galactic system.

THE MICROSCOPE SUBSTAGE AND ITS ADJUSTMENTS.

There are one or two points, particularly in the substage arrangements, which are distinct and characteristic of English and Continental microscopes. In the English instrument of any pretensions it has always been the custom to provide a centring substage, and this carries both the optical portion of the substage condenser and the iris diaphragm. It has to be assumed, therefore, that the iris diaphragm is centred permanently and accurately to the optic axis of the substage condenser, its perfection therefore depending on the extent to which this assumption is justified.

In the case of the Continental microscope, where a centring substage condenser is provided, it is mounted so that the optical part is centred independently of the iris diaphragm, the latter, in fact, being mounted below the substage condenser and having certain adjustments which are in no way connected with the centring arrangement. It therefore follows that in the Continental type the iris diaphragm may be, and indeed often is, permanently out of centre with the optic axis of the objective. The substage condenser has therefore to be centred in relation to two axes, the centre of the iris diaphragm and the optic axis of the objective, which themselves are not in exact alignment. It is obvious that under such conditions the provision and use of a centring appliance for the adjustment of the optical part of the condenser will never result in correct alignment of the various parts. With the object of overcoming this defect, at least in part, some of the better Continental models have been provided with an independent adjustment to enable the mechanic to centre the condenser to the optic axis, after he has centred the iris diaphragm. The condenser is mounted in a ring provided with three screws, the setting of which admits of the optical part of the condenser being centred, but this is, of course, not an adjustment of which the average user would care to avail himself. In the English arrangement, where the iris diaphragm is correctly centred to the substage condenser, centration of the whole substage fitting results in correct alignment with the remainder of the optical system of the microscope.

For the most critical work, therefore, it would appear that the English method is to be preferred. On the other hand, where a microscope is being used for laboratory work, and is only occasionally being used for the testing of objectives or for critical purposes, there is no doubt that the Continental type has much to recommend it. The fact that the iris diaphragm may be contracted to any desired degree, and may then be shifted laterally so that oblique illumination in any azimuth and in any zone of the field of view can be obtained at will, is a great convenience, and for anything like rapid testing of objectives is almost essential.

In the English stand it becomes necessary to provide stops of various sizes and shapes, which can be placed at the back of the substage condenser, to enable oblique illumination to be obtained in any desired manner.

Where absolute accuracy is required it would appear that an arrangement in which both substage condenser and iris diaphragm are capable of independent centration might be a desideratum. In such a case the iris diaphragm would be centred first, and then the optical part of the substage condenser introduced, and that centred independently. By this means the iris diaphragm, the substage condenser, and the objective would be in exact alignment, and the arrangement would be such that work of the most critical character could be carried out. It must be admitted, however, that the conditions under which such a method would become necessary rarely, if ever, arise, so that a well-made instrument provided with the Continental type of substage, in which the iris diaphragm may be decentred, is a very desirable adjunct to any good microscope.

As an indication of the perhaps unnecessary elaboration that has obtained in English stands, one may mention the provision of a fine adjustment to the substage condenser. It is difficult to conceive under what conditions this becomes necessary. A well-made rack-work should provide all the accuracy of adjustment that is required. If it does not it either implies that the mechanical construction of the microscope leaves something to be desired, or that the user has not acquired the necessary manipulative skill to focus his substage condenser with sufficient accuracy, the latter alternative being the more probable.

AUSTRALIAN METEOROLOGY.

The Australian Meteorological Bureau has issued a series of interesting maps showing the normal distribution of temperature and rainfall over the Australian continent. The variety of climate which Australia offers is well illustrated by these charts. The mean summer temperature of the south coast of Victoria (between 60° and 65° F. for January) is about the same as the mean summer temperature of London, while 400 miles to the north the heat is tropical, with a mean temperature of more than 80° F., increasing to more than 85° F. in the greater part of the north-west and central regions. The trend of the isotherms near the coasts shows the usual oceanic effect; they bend southwards in the winter and northwards in the summer in passing from continent to ocean. The isotherms are closest together near the southern coast in summer and near the northern coast in winter.

A fault which might be remedied in future issues is the omission of any scale of distances or parallels of latitude and longitude from the charts.

The rainfall charts have been compiled from data extending over twenty to forty years, with a few stations with only fifteen years' record, indicating that, meteorologically at any rate, Australia is no longer in relative infancy. During the summer months, when the variation of temperature is most rapid near the south coast, the rainfall is greatest on the north and north-east coasts, and the isohyets are closest together in these regions. The distribution gradually changes, and during the winter months the rainfall and its variation are greatest in the south and south-east districts. The change in the position of the isohyets from month to month is very regular; the motion is similar to that of a pendulum, the distribution in the warm months being at one end of the swing and that in the cold months at the other.

In New South Wales, at Forbes, near the centre of gravity of Australia's population, and not far from the site of the new Federal capital, there is practically no variation in the rainfall from month to month; each month has about 2 in. of rainfall. Utilising this fact and the regularity of the change for other regions, the Commonwealth Meteorologist has constructed a rainfall "clock." Isohyets of appropriate shape are drawn on a card placed beneath another card with the outline of Australia cut out of it. The lower card is rotated about an axis through Forbes, and as it moves the rainfall distribution for different months appears, the appropriate positions for each month being shown by an index mark. The remarkable regularity which renders possible this simple device leads the Commonwealth Meteorologist to suggest that Australian meteorology may be of such importance for general investigations as to warrant the establishment of observatories there, internationally supported and controlled.

E. G.

THE RESEARCH DEFENCE SOCIETY.

THE Research Defence Society held its annual general meeting on Tuesday, June 24, at the Royal College of Physicians. The chair was taken by the president of the society, Sir David Gill, and there was a very large attendance. The speakers were:—Bishop Frodsham, founder of the Australian Institute of Tropical Medicine; Sir Thomas Barlow, president of the Royal College of Physicians; Lord Cromer, Sir Hugh Bell, and Mr. Waldorf Astor. The report, presented by Mr. Sydney Holland, chairman of committee, gave a good account of the society's work during the past year with special reference to the campaign against anti-vivisection shops. It stated also that the council of the Royal Society for the Prevention of Cruelty to Animals is sending out a referendum to all the members of that society. The point is, whether it was right or wrong to reject Lord Cheylesmore from the council of the Royal Society for the Prevention of Cruelty to Animals on the ground that he is a vice-president of the Research Defence Society. Seeing the advantages which animals have gained from experiments on animals, and the many restrictions placed on experiments on animals in this country, we think that a man may very properly hold office in both societies; and we are glad that Lord Cromer and Sir Hugh Bell spoke very strongly on this point.

Mr. Waldorf Astor, in an admirable speech, referred to the good news, this week, that the Government has allotted 57,000*l.* annually to research in relation to tuberculosis, and has appointed the Committee and the Advisory Council for this great work. Sir Thomas Barlow spoke of that unity of purpose which is between the men of science and the men in practice: how the doctor and the surgeon are indeed guided and helped by the physiologists and pathologists. Bishop Frodsham spoke of the Christianity of all work done, carefully and wisely, for the relief of suffering humanity; and, as Bishop of North Queensland, he has seen more than most of us of the misery caused by certain obscure tropical diseases, and has done more than most of us to alleviate it. Thus the subject which the Research Defence Society exists to popularise was presented from diverse points of view. Take what point of view we will, it is a subject of national importance.

THE BELFAST MEMORIAL TO LORD KELVIN.

THE statue of Lord Kelvin which has been subscribed for by the citizens of Belfast was unveiled by Sir Joseph Larmor, M.P., F.R.S., on Thursday last, June 19, in the presence of a large and distinguished gathering. The Chancellor of the Queen's University (the Earl of Shaftesbury, K.P.) presided, and the attendance included the Lady Mayoress of Belfast, the Vice-Chancellor of the Queen's University of Belfast, members of the Senate of Queen's University, and many of the leading citizens of Belfast.

In the course of his remarks, the chairman said that from the time of the death of Lord Kelvin the wish was uppermost in his (Lord Shaftesbury's) mind —as indeed he felt sure it was in the mind of everyone present—that there should be erected within the city of Belfast a fitting memorial to a man whose fame had gained for him a paramount position in the city of his birth and in the city with which he and his family were so intimately connected, as well as in the whole world. That day they were to see the consummation of their aspirations, and he offered his warmest thanks to Sir Joseph Larmor, who had so kindly come to perform the unveiling ceremony.

Sir Joseph Larmor then delivered an address, of which the main part is subjoined:—

I am deputed to represent on this occasion a company of subscribers, our fellow-citizens, who have thought it right that the genius of Lord Kelvin, and the great activities which kept him in the forefront of the advance of physical science in an age in which it has transformed the world, should receive permanent commemoration in the city of his birth and parentage, in the community among whom he passed the early years of his life, and to whom, in his later years, he put in an almost passionate claim that he belonged. We do not forget how profoundly he was moulded by the great city of Glasgow, with which his active career was so conspicuously associated. The intimate conferences from his early manhood with the pioneers of industrial development such as that city has possessed ever since the days of James Watt—discussions along the lines of unfolding problems of mechanical power, of naval construction, of the art of navigation—were just what was required to develop the student and natural philosopher into his other aspect, more familiar to the world at large, as the prophet and guide in the utilisation of the vast opportunities opened up, for the practical convenience of life, by modern scientific discovery. By no amount of mere natural ingenuity, after the manner of an inventor or a man of affairs, could anyone have attained to this position; an essential condition was sustained intellectual discipline such as Lord Kelvin enjoyed from his early years.

Fortunate in his home training, here and at Glasgow, under the careful and most competent direction of his father, he had completed the excellent general education which the University of Glasgow then afforded at an age when, in our leisurely days, he would still have been a schoolboy. He was thus able, like many a Scotch and Irish student before and since, to enjoy to the full the opportunities for advanced study, for initiation into the flowing tide of knowledge, which the University of Cambridge has always afforded to those who have known how to search for them with self-reliance and sincerity. And he had the good fortune to be able to combine serious studies, in a noteworthy degree, with active and fruitful relaxation; for he was one of the founders of the University Musical Society, and at the same time a prominent and successful oarsman. Thus he was not tempted to blunt his intellect, even temporarily, by early over-exertion; and though the examiners were not able to assign him the first place in the race for degrees over the limited prescribed course, even that was prejudged, for they were well aware, as one of them expressed it, that there was a man among the candidates they were to test whose pens they were scarcely qualified to mend. By the continued forethought of his father he passed on from Cambridge to Paris, then the chief centre of mathematical and physical science; he arrived provided with ample personal introductions, so that the diary which he sent home gives a most interesting account of the lives and activities of the investigators who were there at work in the middle of the last century. Young as he was, we can recognise that he moved among them on equal terms, and could impart as much as he gained. Inspection of his notebooks of this period, which fortunately have been preserved, and may in time be given to the world, shows that, as has been the case with so many men of genius, the main formative ideas came to him in early years. These rough records reveal that in his student time at Cambridge, or very soon after, he was already in effective possession of most of the advances which he gradually matured and made public during the next ten years: the period in which he was chiefly concerned with the theoretical side of electrical science. When, nearly twenty years ago, in the height of his fame, he took part in the centenary celebration of the Institute of France as one of its eight foreign associate members, he recalled his obligations to Paris and to her great men of fifty years before, in words of dignity and charm which sent a thrill of patriotic pleasure through the brilliant audience that he addressed. He was equally at home, and enjoyed equal affection and honour, among his compeers in Berlin, in Rome, in Washington; in fact, he had come in his later years to be venerated as embodying the universal ideal of the scientific spirit, transcending all limitations of nationality.

The fame and achievement of Lord Kelvin thus belong to all the world; yet we of Ulster have taken care to assert our special interest in his career. I am sure he would have cordially welcomed our claim that he is of ourselves. The connection of the Scottish universities, especially that of Glasgow, with the Ulster people has been intimate and prolonged. In the eighteenth century these great institutions were, owing to racial and religious affinities and geographical proximity, a main centre of our own higher education. But if we were thus under obligation to Scottish learning and intellect, there is also the other side of the account. In Francis Hutcheson, Ulster gave to Glasgow the pioneer of the Scottish school of philosophy, and one of the great names in the history of ethical speculation. Somewhat later we sent from Belfast to Glasgow and Edinburgh one who will always be held in honour, as chief among the founders of modern chemistry, Joseph Black, the clear-sighted discoverer of latent heat and of fixed air, the congenial friend of Adam Smith, David Hume, and Lavoisier. In our own time we gave the great man whom we now commemorate, supreme both in unfolding the intellectual foundations of physical science and in stimulating its fertile applications in an age of which they have been the special characteristic.

Our interest in Lord Kelvin has another aspect, namely, that in this city we have been in a very direct sense his scientific pupils. When some of us were students at the Queen's College, now the University, the chair of natural philosophy was held by Prof. Everett, who had come to us direct from service as Lord Kelvin's assistant in the University of Glasgow, and whose whole scientific activity and enthusiasm were directed towards the exposition of his master's fundamental work with which he had been thoroughly imbued in Glasgow; it was then fresh, and indeed largely in the making, and, it must be admitted, no easier for us (his students) to understand on that account. We had here, as professor of engineering, his elder brother, James Thomson, afterwards also given to Glasgow, a pioneer, greater than we then knew, in the consolidation of science with practice; the volume containing his scientific papers, recently published, bears witness to his ample share in the genius of the family, and to his intimate relations with Lord Kelvin. We had Thomas Andrews as professor of chemistry, whose profound scientific achievements, executed with modest apparatus of local construction, have shed permanent lustre on his native province. And not least, we had John Purser as professor of mathematics, a congenial scientific and personal friend of Lord Kelvin, at the same time in close contact with his own famous mathematical school of the University of Dublin, one of the choice minds of the time, who was wont to enchant those of us who could follow him by brilliant informal discourse about the problems of the day. The scientific work of Lord Kelvin was thus closely appreciated and studied among us here, as early as it could have been anywhere; he has been a permanent element in the intellectual life of the city of his early years, and on that account this local memorial, so spontaneously provided by his fellow-citizens, is a most appropriate tribute to his memory.

His name will pass down the ages as the outstanding guiding spirit of the period when the weapons of physical science were brought out of her secluded armoury, and turned to the reconstruction of our material civilisation. For we have now passed on rapidly from the age of steam into the age of electricity; we have had the good fortune to watch in our own day the progress of that subtle agency of silent power, until it has transformed most of the departments of industrial and social life. The dreams which were mixed with the wonder of the early electric discoverers have been more than accomplished. But this advance has become possible only by being the most conspicuous example of ordered and persistent scientific method that the world has seen. Every minute natural manifestation of electric agency, whether detected by the foresight of men like Faraday, or revealed in part by accident, has had to be accurately and closely analysed, as a prelude to eliciting its possibilities on an industrial scale. The method of true progress must have been impressed especially upon Lord Kelvin during those strenuous telegraphic years, when he was by force of circumstances dragged out of his study to battle with practical engineering difficulties—when, by submitting every phenomenon to that refined measurement and calculation which alone can lead to long secure trains of prediction and adaptation, he transformed the problems of submarine telegraphy from a blind, impracticable tangle into an ordered science. That achievement proved to be the crucial step in preparation for the present age of electricity. His disinterested persistence, through many subsequent years, in the same self-appointed task of rational measurement of electrical quantities and their relations, with the aid of the colleagues whom his zeal enticed into the service, formed the preparation, in all essentials, for uninterrupted progress, as soon as opportunity came in the world of affairs for the larger industrial electric developments to be pushed on. When these immense engineering advances were in full evolution, he was growing old, but his eager foresight still dominated the practical field.

Only in one respect did he fall short, in the theoretical electric advance, when he arrested his fruitful trains of inference on the interconnections of these partially concealed agencies, in order to search strenuously during long years for their complete elucidation, in some form such as could be exhibited and probed in a mechanical working model. Through this partial lapse of faith, this logical reluctance to take risks in following up the incomplete clues offered by nature, it fell to the most illustrious of his pupils and disciples, Clerk Maxwell, with greater daring and temporary disregard of difficulties, yet ever stimulated and guided by his master's own most instructive and inspiring though halting efforts, to connect light and heat in close linkage with electricity and magnetism, and so embrace all branches of physical science in one compact synthesis. This has been the great fundamental achievement in physical science of our age, probably the greatest since Newton announced and developed the law of gravitation. With the eye of faith, waves precisely the same in kind as those of light, only vastly magnified in size, had thus already been familiar to the initiated for twenty years, with fully mental vision of their constitution and behaviour, flashing across space in electric pulses, when at length, by an accident such as comes only to the worthy, the crowning honour of first detecting their actual bodily existence was grasped by Hertz. Then, as is usual in such cases, once a practical start has been gained—the more recent advance in the practice of artificial flight is another example—development was pushed rapidly on in many hands, by theory and experiment working together, until phenomena that it had taken a quarter of a century for eager expert searchers to detect at all, have now become, in the form of wireless telegraphic signals, almost a commonplace of everyday life.

We can recall some of the personal qualities of the great man whom we here commemorate, his splendid unconscious humility, his gentleness, his keen interests and enthusiasm, and readiness to learn from every true worker and to help him onward, his patience in controversy combined with the tenacity that indicates seriousness of purpose. In the words transferred to him by Huxley, a stout opponent in more than one discussion, "Gentler knight there never broke a lance."

Sir Joseph Larmor, on concluding his address, said it was his privilege to ask Sir Robert Anderson to accept, on behalf of the city of Belfast, that memorial to one of the great men whom Belfast and the province of Ulster had given to the Empire.

Sir Robert Anderson said that he esteemed it a very high honour to be asked to occupy the place on that occasion of the Lord Mayor, and to take over from his townsmen the custody of that beautiful memorial. He could assure them for the Corporation that the statue would receive every care and attention. He had no doubt that future generations would appreciate that memorial, not only as a work of art, but also for the influence it would exercise in stimulating students to try to emulate Lord Kelvin.

The Vice-Chancellor of Queen's University proposed that the best thanks of the subscribers be given to Sir Joseph Larmor for unveiling the memorial, and for his address. Proceeding, he referred in eulogistic terms to Sir Joseph Larmor's scientific work, and spoke with pleasure of the early association of Sir Joseph Larmor as a student of the Queen's College, Belfast. The proposal was seconded by Sir Otto Jaffé, and carried with acclamation.

At the close of these proceedings, the statue was unveiled by Sir Joseph Larmor amidst the applause of the assembled company. The ceremony concluded with a vote of thanks to the sculptor.

Lord Kelvin's statue, Botanic Garden Park, Belfast. Photographed by Mr. A. R. Hogg, Belfast.

Description of the Memorial.

The Botanic Gardens is one of the public parks of Belfast, and is situated about a mile and a half from the centre of the city. The position chosen for the statue adjoins the site of the new public museum which is shortly to be built.

The statue is the work of the well-known sculptor Mr. Albert Bruce-Joy. The figure itself is about 10 ft. high, and stands on a granite pedestal of about 13 ft. in height. As our illustration shows, the late

Lord Kelvin is represented standing erect. In the extended left hand there is a design of one of his discoveries—the adaptation of a gyroscope—and in the right hand is a pencil pointing to the drawing. By the side of the figure stands a representation of the Kelvin compass.

The inscriptions are as follows:—

The front of the pedestal bears the single word "Kelvin." On the right side is the following inscription:—

Sir William Thomson, Knt.,
Baron Kelvin of Largs,
P.C., O.M., G.C.V.O.,
Born in Belfast, 1824,
of Ulster Lineage.
Died at Largs, 1907.
Lies interred in Westminster Abbey.

The inscription on the left-hand side of the pedestal reads as follows:—

President of the Royal Society,
Chancellor of the University of Glasgow,
Following 53 years of service in the
Chair of Natural Philosophy.
Pre-eminent in elucidating
The Laws of Nature and in applying them
to the service of Man.

Memorial Tablets.

It may be mentioned that the committee in charge of the memorial has made provision for the placing, in the Hall of Queen's University, of a brass tablet in memory of Lord Kelvin's brother, Prof. Sir James Thomson, who filled the chair of engineering in Queen's College, Belfast, from 1857 to 1873.

A brass tablet is also to be placed in the Common Hall of the Belfast Royal Academical Institution as a memorial to Lord Kelvin's father, Prof. James Thomson, who was professor of mathematics in the Belfast College from 1814 to 1832. In addition, a memorial plate to Lord Kelvin is to be placed in the City Hall, as well as a tablet upon the house in College Square East, Belfast, where Lord Kelvin was born.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Leeds.—Dr. H. S. Raper, lecturer in pathological chemistry in the University of Toronto, has been appointed lecturer in chemical physiology.

The chair of applied chemistry (chemistry of leather manufacture), which becomes vacant on October 1 by the resignation of Prof. H. R. Procter, will be occupied after that date by Dr. E. Stiasny. Dr. Stiasny has been assistant-professor in the department for the last four years, and was previously professor in the Imperial Institute for Leather Industries at Vienna.

The University has recently received a valuable addition to its scientific collections in the presentation by Mrs. A. H. Clarke, of Earl's Court, of the collection of Continental and exotic Macrolepidoptera made by her late husband. The collection enriches the entomological resources of the University by more than 12,000 specimens, all carefully set, arranged, and labelled, and to this Mrs. Clarke has generously added her husband's working library of entomological literature, itself a present of great value and utility. The University authorities wish it to be known, in conformity with Mrs. Clarke's desires, that, after the immediate work of arranging and cataloguing has been concluded, the collections will be available for reference by entomologists generally upon application to the professor of zoology at the University.

London.—The Senate on June 18 re-elected Dr. W. P. Herringham as Vice-Chancellor for a second year. Four new appointments were made to University professorships, including Mr. E. H. Lamb to the chair of civil and mechanical engineering, tenable at East London College, and Dr. C. G. Seligmann to a part-time chair of ethnology at the London School of Economics. The title of emeritus professor was conferred upon Sir William Ramsay. Lord Haldane was appointed Creighton lecturer for next session.

The D.Sc. degree has been granted to E. R. Watson, an external student.

An anonymous donor has offered 300*l*. towards the institution of a lectureship in palæobotany at University College.

The prize distribution and conversazione of King's College, King's College for Women, and King's College Theological Department will be held at King's College, Strand, on Wednesday, July 2.

The Hon. Mrs. Ronald Greville, daughter of the late Mr. William McEwan, a munificent benefactor of the University of Edinburgh, has presented to the University Mr. McEwan's Edinburgh residence.

The title of emeritus professor of engineering has been conferred by the governing body of the East London College (University of London) upon Prof. D. A. Low, professor of civil and mechanical engineering, who has served in that institution for twenty-six years.

The prize fellowship of 120*l*. offered by the Federation of University Women has been awarded to Miss M. A. Whiteley, D.Sc. Dr. Whiteley is assistant-lecturer in chemistry at the Imperial College of Science and Technology, and is the author of several communications dealing with compounds of the barbituric acid series, and published in the Proceedings and Transactions of the Chemical Society.

The West Riding of Yorkshire Education Committee has decided to include in the vacation course to be held during August at the Bingley Training College, a laboratory course of experimental science, with lectures and discussions, under the direction of Prof. A. Smithells. This course is intended for science teachers in secondary schools, and especially for those who teach the subject to girls and desire to acquaint themselves with methods of correlating it with domestic subjects. It will relate chiefly to the subject of combustion and will discuss general questions connected with the teaching of elementary physical science, with special reference to experimental work; provide examples of the teaching of science in relationship to the phenomena and appliances of daily life and especially of domestic life; and give a connected account of the modern science of combustion and the chemistry of flame. The course is open to all teachers of science on the payment of the fees. Full particulars can be obtained on application to the Education Department, County Hall, Wakefield.

The Royal Commissioners for the Exhibition of 1851 have made the following appointments under their scheme of science research scholarships, upon the nomination of the universities and colleges mentioned. The scholarships are of the value of 150*l*. per annum, and are ordinarily tenable for two years:—University of Edinburgh, H. Levy; University of Glasgow, A. Gray; University of St. Andrews, R. F. Thomson; University of Birmingham, W. E. Garner; University of Bristol, F. G. Wilson; University of Leeds, H. Ogden; University of Liverpool, J. H. T. Roberts; University of London, W. B. Haines; University of Manchester, J. Chadwick; Armstrong College, Newcastle-on-Tyne, S. Robson; University College, Nottingham, T. A. Smith; University of Sheffield, C. C. Bissett; University College of North Wales, Bangor, R. Jones; University College, Cork, J. C. Johnson; University College, Galway, H. N. Morrison; McGill University, Montreal, O. Maass; Queen's University, Kingston, Ontario, J. R. Tuttle; University of Sydney, S. E. Pierce; University of Melbourne, N. R. Junner; University of New Zealand, P. W. Burbridge.

WE learn from *Science* that the total State grant to the University of California for the next biennium amounts to about 771,400*l*. Among the items contributing to this large sum may be mentioned:—Support and maintenance of the University, 80,000*l*.; agriculture—support and maintenance of all branches —140,000*l*.; replacement of buildings and equipment at Lick Observatory, 10,000*l*.; University extension, 10 000*l*.; Scripps Institution for Biological Research, 3000*l*.; 200 acres for experiment station in southern California, 12,000*l*.; laboratory building for experiment station in southern California, 20,000*l*.; the State University fund to be automatically appropriated during the coming two years for the support and maintenance of the University, amounting in total to 361,000*l*. From the same source we find that Yale University will received 95,000*l*. from the estate of Dr. Francis Bacon, who died last year. Mrs. Mary Emery has contributed 25,000*l*. to the Ohio-Miami Medical College of the University of Cincinnati for the endowment of a chair of pathology; and a sum of about 16,000*l*. from the estate of Dr. Francis Brunning has also been received by the University, the income of which will be used for the endowment of a second chair.

AN appeal for funds for the Home Science Department of King's College for Women has been issued. It is signed by Lord Rosebery, as Chancellor of the University of London, as well as by the Vice-Chancellor and Principal of the University. A site of $2\frac{1}{2}$ acres of Blundell House grounds on Campden Hill has been secured, and private gifts to the amount of 100,000*l*. have been subscribed during the last year and a half towards endowment, building of laboratories, and hostel. The London County Council has also made a maintenance grant to the department, thereby showing appreciation of the value of the courses, and the Exchequer grant to King's College for Women was made partly in respect of the work of the Home Science Department. The University has approved the granting of a diploma in household and social science, and in view of the new status thus assured it is necessary to complete the college by providing, in addition to laboratories and the hostel, lecture rooms and teaching rooms, common rooms for staff and students, and that accommodation essential to the life of a college or institution of a university character. A library will be needed, also a refectory. For this purpose a further sum of 50,000*l*. is required. Donations may be sent to the bursar, Home Science Department, King's College for Women, 13 Kensington Square, W.

DR. F. W. MOTT gave the third Chadwick lecture at the Royal Society of Arts on Friday, June 20. Sir James Crichton Browne was in the chair. The subject of the lecture was "The Influence of Nutrition and the Influence of Education on Mental Development." Dr. Mott commenced by pointing out the close association of body and mind; he observed that the child's brain, in order to grow and develop mental powers, must have the innate capacity to grow, and a proper supply of pure oxygenated blood wherewith it can take up the necessary materials for growth and function. A pure blood-supply, he argued, could only occur in a normal healthy body in which all the organs and tissues were cooperating for the common weal; the body could only be maintained in health by adequate and proper nourishment amidst hygienic surroundings. He next referred to collective and individual responsibility in respect to the child's nurture and mental development, and proceeded to give physiological reasons why the brain required stimulus from without for development. The importance of the tactile muscular sense, which contributes to every other sense, was emphasised, and he showed how the minds of Laura Bridgeman and Helen Keller were developed to a high degree of intelligence through the finger-tips. Sleep, rest of the brain, and the storage of mental energy were next touched upon as an important factor in the development of mind. Dr. Mott then passed on to consider the improvements in some modern systems of education; the happy passing away of the old system of payment of teachers by results, the desirability of educating according to physiological principles of development of function. The object of education should be to develop the physical, intellectual, and moral characters of the individual so as to make a final efficient product to fill a place in the social organism.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, June 11.—Dr. Aubrey Strahan, president, and afterwards Mr. W. Whitaker, in the chair.—Dr. Hans **Salfeld**: Certain Upper Jurassic strata of England. The localities dealt with are the Dorset coast from Kimmeridge to Abbotsbury, and the Wiltshire exposures at Swindon and Westbury. The formations concerned are the Portlandian, Kimmeridgian, and for a starting-point the Upper Oxfordian. The Upper Oxfordian = upper part of the English Corallian (+Kimmeridge Clay locally) is divided into three zones, found at Osmington, Westbury, and Swindon. The Kimmeridgian is divided into five zones, and is equal mainly to the Lower Kimmeridge Clay of English authors. The Portlandian is divided into nine zones; but the term as used includes the Portland Oolites, Portland Sands, and Upper Kimmeridge Clay of British authors. Three new genera of ammonites are named, and two new zonal species of ammonites defined.—A. **Jowett**: The volcanic rocks of the Forfarshire coast and their associated sediments. In Forfarshire these sediments are frequently amygdaloidal, the production of the cavities having been accompanied by the buckling and fracturing of the layers of sediment. Such effects may result from the pouring of molten rock over wet unconsolidated sediment; steam being produced within the sediment, but unable to escape owing to the presence of the overlying rock. Further evidence of the pouring of molten rock into water is furnished by the occurrence of a rude pillow-structure in some of the lavas. Several lenticular conglomerates are interbedded with the volcanic rocks, resting upon eroded surfaces of the latter. Most of the volcanic rocks are olivine-basalts, rhombic pyroxene as well as olivine sometimes being present. Some contain rhombic pyroxene to the exclusion of olivine. The fine sediments consist of a variable proportion of quartz and mica and a little felspar, together with chlorite, iron oxides, and occasional minute fragments of volcanic rock. Calcite, quartz, chalcedony, and chlorite are the commonest minerals in the amygdales, in both lavas and sediments.—J. **Parkinson**: A group of metamorphosed sediments situated between Machakos and Lake Magadi in British East Africa.

Physical Society, June 13.—Prof. C. H. Lees, vice-president, in the chair.—G. E. **Bairsto**: Some experiments on tinfoil contact with dielectrics. This paper describes some experiments showing how the accuracy of the different kinds of electrical measurements that are made on condensers is influenced by the use of an imperfect tinfoil contact. While considerable errors are liable to be made in deducing the specific direct-current conductivity of a dielectric between tinfoil armatures, the same is not true for measurements of the alternating-current conductivity. The influence of the bad contact is twofold. First, it decreases the apparent capacity by inserting in series with the condenser under test a very large but still finite air condenser. This causes a decrease in the measured conductance. Secondly, because of the decrease in area of contact, it decreases the magnitude of that component of the conductivity which is independent of the frequency—*i.e.* the purely ohmic conductivity. It is shown experimentally, even under the worst possible circumstances, the dielectric being only lightly bound up with the interleaved tinfoil, that for telephonic frequencies the maximum difference between the observed conductivity and true conductivity is 15 per cent., and of capacity 5 per cent. With the condenser tightly bound with tape and wedges of wood inserted, the maximum difference was only 4·5 per cent. in the conductivity and 2·5 per cent. in the capacity. Finally, the influence of imperfect contact upon the accumulation of residual charge is considered.—G. D. **West**: A method of measuring the pressure of radiation by means of thin metal foil. The pressure of the radiation emitted by a carbon filament lamp at a distance of a few centimetres is sufficient to cause a microscopically measurable deflection of the end of a suspended strip of gold or aluminium foil, and by this means the radiation pressure can be calculated knowing the weight of the strip. The results agree to within about 10 per cent. with the energy content per cubic centimetre as measured by the initial rate of rise of temperature of a copper plate exposed to the radiation. The best results are obtained by working in an atmosphere of hydrogen, 1 cm. to 2 cm. pressure, but good results are obtained with hydrogen at atmospheric pressure. Air at 1 cm. to 2 cm. pressure also gives good results. —Dr. W. **Wilson**: The emission of electricity from hot bodies and the quantum theory. The paper gives a theory of the emission of electricity from hot bodies which is based on the quantum theory of energy. A formula connecting the thermionic current and the temperature of the emitting body is deduced. This formula closely resembles that of Richardson, and agrees slightly better with experimental results.

Mineralogical Society, June 17.—Dr. A. E. H. Tutton, F.R.S. president, in the chair.—W. L. **Bragg**: Crystal-structure as revealed by Röntgen radiation. An analysis of the diffraction patterns obtained when X-rays traverse a section of a crystal shows that in many simple crystals the diffraction is caused by a set of points arranged on a space-lattice. That is the case when the molecule contains either a single heavy atom of at least twice the atomic weight of the other constituents, or only two atoms of nearly the same atomic weight. By comparison of the patterns given by certain alkaline halides, such as KCl and KBr, a definite structure of these cubic crystals is clearly indicated, and it would appear that the atoms are arranged on a space-lattice the elementary parallelopiped of which is a cube, alternate atoms being along the axes, so that the atoms of one kind form a face-centred cubic space-lattice. These conclusions are confirmed by a comparison of the distances between planes parallel to the various faces of these crystals carried out by means of the X-ray reflection-spectrometer, and it appears that a single atom is associated with each point of the space-lattice which diffracts, in the case, for instance, of the alkaline halides, calcite, fluor, blende, and pyrites. If the suggested structure of the crystals is correct, a simple calculation gives the absolute wave-length in centimetres of the homogeneous components in the X-ray beam from a platinum antikathode.—H. V. **Ellsworth**: The crystal habit of topaz from New Brunswick, Canada. Topaz, a rare mineral in Canada, occurs in York County, New Brunswick, associated with wolframite, molybdenite, and a little fluor. On the crystals the forms 110, 120, 011, 112, are prominent, but other pyramid and prism forms are sometimes present, sixteen forms altogether being observed. Dull faces were coated with silver by Brashear's process, in which an ammoniacal solution of silver nitrate is reduced by a sugar solution.—Dr. G. T. **Prior**: The meteoric stone which fell at Baroti, Punjab, India, in September, 1911. The stone, which belongs to the "intermediate chondrite" group of Tschermak's classification, was found on analysis to contain about 9 per cent. of nickel-iron and 7 per cent. of troilite, which were disseminated in small particles through a colourless matrix of enstatite and olivine showing only few chondrules.—Dr. A. W. **Gibb**: Kämmererite from Unst, Shetland Islands.

Royal Meteorological Society, June 18.—Mr. C. J. P. Cave, president, in the chair.—J. S. **Dines**: Pilot balloon observations in Barbados, 1911–12. These balloon ascents were carried out by Prof. J. P. d'Albuquerque and other gentlemen, on behalf of the joint upper air committee of the Royal Meteorological Society and the British Association. Great difficulties were experienced in carrying out the work, the most serious of which was due to the adverse effect of the climate of Barbados on the rubber fabric of the balloons, thus causing them to deteriorate more rapidly than in colder regions. Consequently no very high ascents could be obtained.—H. W. **Braby**: The Harmattan wind of the Guinea coast. This is a north-east wind which blows during the winter months along the coast of Upper Guinea from French Guinea to the Cameroons. It is exceedingly dry and brings with it fine sand which enters the crevices of doors and windows, covering everything with a film of dust. The sun is partially obscured and distant objects become invisible. This wind, which blows intermittently from November to March, is locally known as "the doctor."—Dr. E. C. **Snow** and J. **Peck**: The correlation of rainfall. The authors dealt with the monthly rainfall from a number of stations in the south-eastern counties of England for the four years 1908–11, and found that the rainfall in two or three of the months is more highly associated with that in certain other months than with the rainfall in the remaining months.

DUBLIN.

Royal Irish Academy, June 9.—Prof. Sydney Young, F.R.S., vice-president, in the chair.—R. **Southern**: Clare Island reports. (1) *Polychaeta errantia*. In this paper the families Syllidæ to Paraonidæ were treated systematically. The total number of species found in these families was 143. Of these, nine were described as new, belonging to the genera Sphærosyllis (1), Pionosyllis (1), Streptosyllis (2), Opisthodonta (1), Pholoë (1), Præegeria (1), Mystides (1), and Paronides (1). A new genus, Prægeria, was described, belonging to the family Pisionidæ, previously known only from the west coast of South America. In addition, twenty species were added to the British fauna. (2) Hirudinea. The leeches found in the Clare Island area comprise eleven species, of which six are freshwater species, and five are marine. Of the freshwater forms, *Hemiclepsis marginata* was found for the first time in Ireland.—E. **Heron-Allen** and A. **Earland**: Foraminifera from the area of the Clare Island Survey. The authors have worked out as independent units of their study thirty-seven stations in the area. Of these, eleven were shore-sands, five were dredgings taken by themselves from small boats, and the rest were dredgings made by them on board the fisheries cruiser *Helga*, kindly placed at their service by the Irish Fisheries Board. The authors record fifteen species new to science, thirty-five species new to Great Britain, and twelve species recorded for the second time in British waters. The most important contribution to zoology is a complete revision and rearrangement of the genus Discorbina, the affinities of which have become almost hopelessly confused in the literature of the subject. Altogether two hundred and ninety-nine species are recorded from the district.

Paris.

Academy of Sciences, June 16.—M. F. Guyon in the chair.—P. **Appell** and H. **Vergne**: A transformation of a movement of a given conservative holonomial system into the movement of another system given the same freedom.—Charles **Moureu** and Georges **Mignonac**: The ketimines. It is suggested that imines derived from aldehydes of the type R.CH : NH should be termed aldimines, whilst those derived from ketones of the type RR'.C : NH are called ketimines. A new general method of preparing the latter is described based on the condensation of a nitrile with alkylmagnesium bromide, and the treatment of the compound thus formed with hydrochloric acid in dry ether under special conditions. Eight ketimines have been prepared, the properties of which are given.—M. de **Forcrand**: The Trouton coefficient and the heat of vaporisation of pure bodies boiling at low temperatures. Data for helium. The empirical formula recently proposed by the author is applied to the cases of chlorine, radium emanation, oxygen, nitrogen, hydrogen, and helium, and the values calculated for the latent heats of vaporisation compared with the experimental figures; the agreement is fairly satisfactory. The case of helium is dealt with in detail.—Eugène **Fabry**: An attempt at a demonstration of Fermat's theorem.—H. **Jonas**: A transformation which depends on a partial differential equation of the third order.—Paul **Montel**: Total differentials and monogenous functions.—Michel **Petrovitch**: Hypertrigonometric series.—Ch. **Platrier**: The holomorphic solutions of certain linear integral equations of the third species.—Theodor **Poschl**: The canonical equations of non-holonomial systems.—Z. **Carrière**: A new method of measuring the velocity of fluids. A small jet of steam is introduced into the flowing gas the velocity of which it is required to measure. A series of small isolated clouds is formed, which are studied by a rotating mirror and a formula deduced giving the velocity.—Marcel **Moulin**: The terminal curves of a chronometer balance spring.—Pierre **Weiss**: The magnetisation of crystals and the hypothesis of the molecular field.—G. **Sagnac**: Interferential strioscopes and simplified interferometers with inverse circuits. Stationary vibrations on a transparent silver film.—F. **Bodroux** and F. **Taboury**: The bromination of some ketones and some secondary hydroaromatic alcohols. The method of bromination of *cyclo*hexanone and *cyclo*hexanol described in a previous paper has been extended to some homologues of these compounds.—J. **Durand**: The fossil shells in inclusions in the clear crystals of gypsum of the Oligocene at Narbonne. The shells observed include Potamides, Lymnœa, Planorbis, and Helix. The inclusion of such shells in gypsum crystals appears not to have been noted before; it is of interest as regards the theory of the formation of certain gypsums.—L. **Reutter**: Chemical researches on cocoa seeds.—P. A. **Dangeard**: The action of radiation in a mixture of colouring matters. A mixture of chlorophyll and pinaverdol was exposed on a collodion film to light; the pinaverdol is transformed and finally destroyed by the energy absorbed by the chlorophyll. Pinaverdol exposed under similar conditions in the absence of chlorophyll to light is unaffected.—Y. **Manouélian**: Researches on the cardiac plexus and on the innervation of the aorta.—Marcel **Belin**: The action of oxidising substances on toxins *in vivo*. The experiments were made with guinea-pigs and the oxidising substance employed was sodium chlorate in doses of 0·08 gram per kilogramme of body weight. A favourable action was observed with typhoid fever and streptococcus infections.—Charles **Nicolle** and A. **Conor**: Vaccinotherapy in whooping-cough. Inoculation with living cultures of Bordet's micro-organism resulted in cure of about one-third of the cases, improvement in a third, and the remainder were stationary. One hundred and twenty-two children were treated, and in no case was the inoculation followed by any general or local reaction.—M. Emm. **Pozzi-Escot**: Researches on the mechanism of the acclimatisation of yeasts to formaldehyde. Formaldehyde loses its antiseptic properties in yeast solution owing to its combination with the amido-compounds present. There is no evidence that formic acid is formed by oxidation.—W. **Kopaczewski**: An analytical dialyser.—Henri **Agulhon**: The action of boric acid on zymase; comparison with the action of phosphates.—Mme. and M. A. **Chauchard**: Quantitative study of the action of monochromatic ultra-violet rays on amylase. The photochemical action of the ultra-violet rays on amylase is proportional to the absorption of these rays by the solution containing the ferment.—Jean **Bielecki** and Victor **Henri**: Quantitative study of the absorption of the ultra-violet rays by monoamines, diamines, nitriles, carbylamines, amides, and oximes of the fatty series.—H. **Zilgien**: The transformation of calomel into soluble mercury salts in the digestive fluids.—Emile **Haug**: The western termination of Sainte-Baume.—Léon **Bertrand** and Antonin **Lanquine**: Tectonic observations in the neighbourhood of Grasse.—E. Hernandez **Pacheco**: The Miocene mammals of Palencia in the Spanish *Meseta*.—Carl **Störmer**: An expedition for the observation of the aurora borealis at Bossekop in the spring of 1913. Six hundred and thirty-six pairs of simultaneous photographs of the aurora were taken, of which 450 pairs were good enough to furnish material sufficient to calculate with great precision the form, situation, and altitude of the principal species of the aurora borealis.

Cape Town.

Royal Society of South Africa, May 21.—The president in the chair.—A. G. **Stigand**: Notes on Ngamiland. A general account of Ngamiland and its inhabitants. —H. A. **Wager**: Some new South African mosses.—W. A. Douglas **Rudge**: Magnetic observation taken at Bloemfontein. In this paper some account is given of the diurnal range of the declination at Bloemfontein during the period from August to December, 1912.

Tables are given showing the daily range of the variation, and also the times of the maximum and minimum declinations to the east. The mean value of the declination is about 24° W. The greatest deviation from this occurs during the afternoon, and amounts in some cases to 7·2 minutes of arc, less than 24°. The total change in the declination has been as much as 10·8 minutes in the day. Twelve curves are given. The change in the position of the maximum, and also of the range, is of the same order as that noted by General Sabine in the records taken at Cape Town more than sixty years ago.—R. B. **Thomson**: Note on the vertebral column of the Bushman race in South Africa. The object of the investigation was to determine whether racial character could be said to exist in the cervical and thoracic vertebræ, such having already been pointed out in the lumbar and sacral regions. The results would tend to show that the bodies of the cervical and thoracic vertebræ are relatively narrower in their anterior-posterior diameter, and deeper in their vertical depth by about 5 per cent as compared with Europeans. The vertebral foramen in both regions is relatively longer, but not to such a marked extent in the thoracic region. The vertical anterior and posterior depths of the bodies of the cervical and thoracic vertebræ show that these vertebræ, in common with the lumbar, are not adapted to the vertebral curves. The adaptation of the curves must therefore be purely undertaken by the cartilaginous disc.

CALCUTTA.

Asiatic Society of Bengal, June 4.—Rasik Lal **Datta**: The action of nitrosyl chloride on secondary amines, methylbenzylnitrosamine and ethylbenzylnitrosamine. The amines experimented with were methylbenzylamine and ethylbenzylamine, the corresponding nitrosamines being obtained as yellowish oils.—Sarat Chandra **Jan**: A new compound of ethylacetoacetate with mercuric oxide. The preparation of the compound $3HgO,4CH_3COCH_2COOC_2H_5$ is described.—Rasik Lal **Datta** and Haridas **Mukherji**: The double mercuri-periodides of substituted ammonium bases. Terrapropylammonium mercuri-periodide. A description of the preparation of the salt $5N(C_3H_7)_4I,HgI_6$ is given.—Hem Chandra **Das-Gupta**: Two-shouldered stone implements from Assam. A short note describing two small stone adzes approaching the Burmese type, obtained from the districts of Tezpur and Cachar in Assam and now in the collection of prehistoric antiquities of the Indian Museum. The occurrence of these implements in areas through which the wave of Khasia immigration may have passed is of some interest in view of the relationships which exist between this tribe and the Mon-Hkmer peoples of Burma.—Prof. George H. **Carpenter**: A new springtail from Galilee. In describing a new species of Cyphoderus from near Tiberias the author notes its resemblance to forms from the valley of the White Nile.—Dr. N. **Annandale**: Polyzoa from the Lake of Tiberias. A large number of specimens of Phylactolæmatous Polyzoa were obtained in the Lake of Tiberias, but only two species were represented, a hitherto undescribed Plumatella, remarkable for its yellow lophophore, and *Fredericella sultana*, Blumh. Reasons are given for regarding the Galilean race of the latter as distinct from the common European form, and particulars of its biology are noted.—Dr. N. **Annandale**: Note on a sponge larva from the Lake of Tiberias. Free-swimming larvæ of Nudospongilla were found to agree in the more important characters with those of Spongilla. In view of the resemblance between the skeleton of the former genus and that of some marine sponges the point is of interest.

BOOKS RECEIVED.

U.S. Department of Agriculture. Weather Bureau. Bulletin x. Hurricanes of the West Indies. By Prof. O. L. Fassig. Pp. 28+xxv plates. (Washington: Government Printing Office.) 1.50 dollars.

Die Süsswasser-Flora Deutschlands, Oesterreichs und der Schweiz. Edited by Prof. A. Pascher. Heft 2, 3, 9, 10. (Jena: G. Fischer.) 5 marks, 1.80 marks, 1.50 marks, 4 marks respectively.

Le Monde Polaire. By O. Nordenskjöld. Traduit du Suédois par G. Parmentier et M. Zimmermann. Pp. xi+324+xx plates. (Paris: A. Colin.) 5 francs.

Les Pyrénées Méditerranéennes. Etude de Géographie biologique. By Prof. M. Sorre. Pp. 508+xi plates. (Paris: A. Colin.) 12 francs.

L'Espèce et son Serviteur (Sexualité, Moralité). By Prof. A. Cresson. Pp. 347. (Paris: F. Alcan.) 6 francs.

Der Manihot-Kautschuk. Seine Kultur, Gewinnung und Präparation. By Prof. A. Zimmermann. Pp. ix+342. (Jena: G. Fischer.) 9 marks.

The Archæological Survey of Nubia. Report for 1908–9. Vol i., part i., Report on the Work of the Season, 1908–9. Part ii., Catalogue of Graves and their Contents. Pp. v+209. Vol ii., Plates and Plans accompanying vol. i. Pp. 16+56 plates+xx plans. (Cairo: Government Press.) L.E.2 the two vols.

Memoirs of the Indian Museum. Vol iii., No. 3. Indian Trypaneids (Fruit-flies) in the Collection of the Indian Museum. By Prof. M. Bezzi. Pp. 53–175 +plates viii–x. (Calcutta: Baptist Mission Press.) 6 rupees.

Measures of Proper Motion Stars, made with the 40-inch Refractor of the Yerkes Observatory in the Years 1907 to 1912. By S. W. Burham. Pp. iv+311. (Washington: Carnegie Institution.)

An Introduction to the Chemistry of Plant Products. By Dr. P. Haas and T. G. Hill. Pp. xii+401. (London: Longmans and Co.) 7*s*. 6*d*. net.

Dent's Practical Notebooks of Regional Geography. By Dr. H. Piggott and R. J. Finch. Book vi. (London: J. M. Dent and Sons, Ltd.) 6*d*. net.

Practical Mathematics. First Year. By A. E. Young. Pp. vii+124. (London: G. Routledge and Sons, Ltd.) 1*s*. 6*d*. net.

Bacon's New Series of County Contour Hand Maps. 16 Maps. (London: G. W. Bacon and Co., Ltd.) 1*d*. net each.

Transactions of the Royal Society of South Africa. Vol. iii., part 2. Pp. 187–339+xiv. (Cape Town: Royal Society of South Africa.) 15*s*.

Livingstone College Year Book. Centenary Number. (Leyton: Livingstone College.) 6*d*.

Carnegie Endowment for International Peace. Year Book for 1912. xvi+165. (Washington.)

Die Bestimmung der Elemente des Erdmagnetismus und ihrer zeitlichen Aenderungen. By Dr. H. Fritsche. Pp. 96+12 charts. (Riga: Müllerschen Buchdruckerei.)

Gas Analysis. By Prof. L. M. Dennis. Pp. xvi+434. (London: Macmillan and Co., Ltd.) 9*s*. net.

Liquid Air, Oxygen, Nitrogen. By G. Claude. English edition, corrected and brought up to date by the author. Translated by H. E. P. Cottrell. Pp. xxv+418. (London: J. and A. Churchill.) 18*s*. net.

The Resistance of the Air and Aviation. Experiments conducted at the Champ-de-Mars Laboratory. By G. Eiffel. Second edition, revised and enlarged.

Translated by J. C. Hunsaker. Pp. xvi+242+xxvii plates. (London: Constable and Co., Ltd.) 42*s.* net.

Catalogue of the Lepidoptera Phalænæ in the British Museum. Vol. xii. By Sir G. F. Hampson, Bart. Plates cxcii–ccxxi. (London: British Museum; Longmans and Co.)

Catalogue of the Ungulate Mammals in the British Museum (Natural History). Vol i. By R. Lydekker. Pp. xvii+249. (London: British Museum; Longmans and Co.)

Catalogue of the Books, Manuscripts, Maps, and Drawings in the British Museum (Natural History). Vol iv. Pp. 1495–1956. (London: British Museum; Longmans and Co.)

The Oxford Geographies. Edited by A. J. Herbertson. Animal Geography. By Dr. M. I. Newbigin. Pp. 238. (Oxford: Clarendon Press.) 4*s.* 6*d.*

Modern Electrical Theory. By Dr. N. R. Campbell. Second edition. Pp. xii+400. (Cambridge University Press. 9*s.* net.

The Land of the Blue Poppy: Travels of a Naturalist in Eastern Tibet. By F. K. Ward. Pp. xii+283+xxxix plates+v maps. (Cambridge University Press.) 12*s.* net.

Treatise on General and Industrial Organic Chemistry. By Dr. E. Molinari. Translated from the second enlarged and revised edition. By T. H. Pope. Pp. xix+770. (London: J. and A. Churchill.) 24*s.* net.

Tables Annuelles de Constantes et Données Numériques de Chimie, de Physique et de Technologie. Vol. ii. Année 1911. Pp. xl+759. (London: J. and A. Churchill.) 28*s.* 6*d.* net.

Junk's Natur-Führer. Tirol, Vorarlberg und Liechtenstein. By Prof. K. W. von Dalla Torre. Pp. xxiv+486+map. (Berlin: W. Junk.) 6 marks.

Eine geographische Studienreise durch das westliche Europa. By W. Hanns and others. Pp. iv+75. (Leipzig and Berlin: B. G. Teubner.) 2.40 marks.

Chemische Plaudereien. By L. Wunder. Pp. v+42. (Leipzig and Berlin: B. G. Teubner.) 1 mark.

Physikalische Plaudereien. By L. Wunder. Pp. v+47. (Leipzig and Berlin: B. G. Teubner.) 1 mark.

Mittelmeerbilder: Gesammelte Abhandlungen zur Kunde der Mittelmeerländer. By Dr. T. Fischer. Zweite Auflage. By Dr. A. Rühl. Pp. vi+472. (Leipzig and Berlin: B. G. Teubner.) 7 marks.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief. 45 and 46. (Jena: G. Fischer.) 2.50 marks each Lief.

La Région du Haut Tell en Tunisie. By Dr. C. Monchicourt. Pp. xiv+487+plates. (Paris: A. Colin.) 12 francs.

Société Française de Physique. Procès-Verbaux et Résumé des Communications Faites Pendant l'Année 1912. Pp. 124. (Paris: Gauthier-Villars.)

Société Française de Physique. Annuaire 1913. Pp. xvi+90. (Paris: Gauthier-Villars.)

Reports from the Laboratory of the Royal College of Physicians, Edinburgh. Vol. xii. (Edinburgh: (Oliver and Boyd.)

Anaphylaxis. By Prof. C. Richet. Translated by Dr. J. M. Bligh. Pp. xii+266. (Liverpool University Press; London: Constable and Co., Ltd.) 3*s.* 6*d.* net.

Further Problems in the Theory and Design of Structures. By E. S. Andrews. Pp. viii+236. (London: Chapman and Hall, Ltd.) 7*s.* 6*d.* net.

DIARY OF SOCIETIES.

THURSDAY, JUNE 26.

ROYAL SOCIETY, at 4.30.—Phosphorescence of Mercury Vapour after Removal of the Exciting Light: F. S. Phillips.—Light Sensations and the Theory of Forced Vibrations: Dr. G. J. Burch.—The Fluctuation in the Ionisation due to γ Rays: P. W. Burbidge.—The Force Exerted on a Magnetic Particle by a Varying Electric Field: J. G. Leathem.—The Luminosity Curve of a Colour-blind Observer: Dr. W. Watson.—A Critical Study of Spectral Series. Part iii. The Atomic Weight Term, and its Import in the Constitution of Spectra: Prof. W. M. Hicks.—A Band Spectrum attributed to Carbon Monosulphide: L. C. Martin. *And other Papers.*

FRIDAY, JUNE 27.

PHYSICAL SOCIETY, at the National Physical Laboratory, Bushy House, Teddington, from 3.30.—Demonstrations of Work in Progress in the Laboratory.

MONDAY, JUNE 30.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Gustave Canet Lecture: The Working Fluid of Internal Combustion Engines: Dr. Dugald Clerk.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

No. 2279, VOL. 91] THURSDAY, JULY 3, 1913 [PRICE SIXPENCE

Registered as a Newspaper at the General Post Office.]

THURSDAY, JULY 3, 1913.

AN EPITOME OF GEOMETRICAL CRYSTALLOGRAPHY.

Statische und kinetische Kristalltheorien. By Dr. J. Beckenkamp. Erster Teil. Pp. viii + 206. (Berlin: Gebrüder Borntraeger, 1913.) Price 9.60 marks.

THE style of this book recalls that of parts of the "Encyclopädie d. math. Wissenschaften." A summary is given of practically the whole of geometrical crystallography, both experimental and theoretical. There is included, for instance, an account of crystalline symmetry and structure theory, together with a description of the common types of twinning, habit, &c. Physical crystallography, including the optical, elastic, and electrical behaviour of crystalline media, lies outside the scope of the book.

It will be readily realised that so large a field cannot be adequately covered in 206 pages. The author confines himself almost entirely to the quoting of results. For example, formulæ are given to obtain the most probable values of the true angles between four crystal-faces from the observed angles, and also formulæ for calculating the angles between these four faces and the remaining faces; but no indication is given of the method of arriving at these results. Again, though the thirty-two crystal classes are described in detail, no proof is given of the fact that there are exactly thirty-two classes—and similarly throughout the treatise.

Dr. Beckenkamp is evidently interested in the history of crystallography; and he begins each section with a historical summary of work done on the subject-matter of that section from the earliest days of the science, with quotations from various authors and valuable references.

The book is illustrated by 303 excellent diagrams, well drawn, and easy to follow except for those illustrating the author's theory of molecular groups, which are on rather too small a scale to be clearly visible.

The style of the work is clear and interesting, and the book is divided into sections of a convenient length, so that the reader is not tired by over-concentration on a particular theme.

The book will be a useful addition to the literature of the subject, especially as a work of reference; but even the beginner will find it attractive, though he will require to supplement it by some work which goes into more detail. Perhaps the least satisfactory part is that dealing with the author's own structure theory. He has scarcely succeeded in making his point of view clear; and, in fact, the task of explaining a new structure theory of crystals in six pages without the assistance of a single mathematical formula would lie beyond the powers of any writer. But doubtless this will be remedied when part ii. appears.

HAROLD HILTON.

A HISTORY OF CHEMISTRY.

A History of Chemistry from the Earliest Times till the Present Day. By the late Prof. J. C. Brown. Pp. xxx + 543. (London: J. and A. Churchill, 1913.) Price 10*s.* 6*d.* net.

THE late Prof. Campbell Brown, of the Liverpool University, was in the habit of delivering annually a series of lectures on the history of chemistry to his senior students as part of their degree course, and he had the intention, on his retirement, of preparing these lectures for publication. His sudden and unexpected death while still in the occupation of his chair prevented him from personally realising his wish. Mrs. Campbell Brown, with the assistance of Mr. Henry H. Brown, and Prof. Brown's late chief assistant, Mr. W. H. Roberts, has, however, sought to give effect to his intention, and the present handsome volume is the result of their labours. Its compilation has obviously been a labour of love, and forms a fitting memorial to a singularly earnest, conscientious, and high-principled man who played a notable part in the educational history of Liverpool, and particularly in the creation and development of its University. Its preparation for press must have been a matter of no little difficulty, and the form in which it is now presented reflects great credit upon Mr. H. H. Brown and his coadjutor.

The original matter was largely in the form of notes, more or less complete, which the lecturer was accustomed to amplify and comment upon at the moment, and there is little doubt that, had Dr. Brown lived to complete the work, much additional matter would have been included. Possibly, also, some omissions and corrections would have been made in the light of more exact knowledge. The book makes no pretensions to research among original authorities, and it is obvious that the lecturer had been content to take his facts and interpretations from well-known sources, such as Thomson, Hoefer, Kopp, Meyer, Ladenburg, Berthelot, and others that might be named. In many cases the illustrations, as well as the phraseology, afford the key to the source of the statements. The book is eminently readable, and may be recommended to the student who

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desires only a very general acquaintance with the main lines of the historical development of the science, without too much critical detail. Considering the immensity of the subject, a great amount of information has been packed into the five hundred pages of which the work consists.

The book is prefaced by a short biographical note in which the main features of Dr. Brown's character, and the chief incidents in what was practically a lifelong connection with Liverpool, are dealt with sympathetically. There is also an excellent and characteristic portrait of the professor by way of frontispiece. T.

REPRODUCTION AND DEVELOPMENT.

(1) *Vertebrate Embryology: Comprising the Early History of the Embryo and its Foetal Membranes.* By Dr. J. W. Jenkinson. Pp. 267. (Oxford: Clarendon Press, 1913.) Price 12*s*. 6*d*. net.

(2) *Problems of Life and Reproduction.* By Prof. Marcus Hartog. Pp. xx + 362. (London: John Murray, 1913.) Price 7*s*. 6*d*. net.

(1) DR. JENKINSON'S "Vertebrate Embryology" will be welcomed by all students of that subject in this country. Hitherto the only book on embryology of convenient size and suitable for elementary students has been Bryce's volume in "Quain's Anatomy," but this work is devoted almost exclusively to human embryology, and is avowedly intended for students of medicine rather than for those taking zoology for an honours degree in science. Dr. Jenkinson's book will not be without utility to the more advanced workers in the subject, including original investigators and teachers. To each chapter there is appended a short bibliography which affords a valuable guide to the literature.

In the first chapter, which is introductory in character, it is shown that the structural differentiation which occurs in embryonic development (and also in later life) takes place by movements either of single cells or of cell aggregates, and finally through the assumption by the cells of the histological characters peculiar to each kind of tissue. It is pointed out further that it is not a process of cell division which produces the differentiation, since differentiation already exists in the ovum prior to segmentation, and is, indeed, the real cause of the differentiations which subsesequently manifest themselves. The second chapter is upon growth, and is illustrated by figures of growth taken mainly from the work of Minot, and showing the daily percentage increments in the weights of man and animals.

Chapters iii. and iv. are upon the germ-cells, and contain admirable accounts of the phenomena of spermatogenesis, oogenesis, and fertilisation. The author accepts the view that the germ-cells are not all formed in or from the germinal epithelium, but that the first to develop come from the endoderm or splanchnopleure (mesoderm) of the gut or yolk-sac, and reach their final resting-place by migrating there. There is no mention, however, of Miss Lane-Claypon's statements (at present unconfirmed) regarding the origin of ova from ovarian interstitial cells after the attainment of sexual maturity. The author states that the follicle cells are also probably derived from the germinal epithelium, but the recent work of Miss McIlroy is not quoted. In referring to the corpus luteum, the author says that this organ secretes a substance which appears to be necessary for the proper attachment of the embryo by means of the placenta. The theory has often been stated in this form, but it now appears to the reviewer that in a work like the present it might be better to assert merely that the hypertrophy of the follicle cells is functionally correlated with the contemporaneous uterine hypertrophy, which is a necessary factor in the growth of the placenta and the nourishment of the embryo, and cannot occur in the absence of luteal tissue in the ovary. The truth of the hypothesis stated in this general form seems to be beyond question, whereas the exact nature of the correlation is a problem which still awaits complete solution.

Space does not admit of more than a passing mention of the succeeding chapters; they deal with segmentation, the germinal layers, the early stages in the development of the embryo, the fœtal membranes, and the placenta. The chapter on the placenta is of especial interest, for Dr. Jenkinson writes with the authority of an original investigator. The physiological side of the subject is not neglected, and there are new and interesting details concerning the œstrous cycle. A word must be added in praise of the numerous illustrations, which, with very few exceptions, were drawn specially for this book.

(2) Prof. Hartog's work consists of a collection of essays contributed at various times during the last twenty-one years to different journals, and embodying his views on certain biological questions of importance. The majority of the articles are republished with little alteration, but the fourth chapter, in which the author's views on the physics of cell-division are put forward, has been almost entirely re-written.

The first chapter is entitled "Some Problems of Reproduction," and contains an account of the author's theory as to the significance of the polar bodies, which are regarded merely as the products of brood-divisions of the ovarian egg.

The author points out that "the abortion of certain members of a brood or group to the favour of others" is a phenomenon of frequent occurrence in nature, and he instances those flowers which produce more ovules than ever ripen into seed. According to his theory, the expulsion of the polar bodies is simply an incident recalling the past history of the race, and the physiological explanations are uncalled for. On this view the remarkable constancy of the phenomenon among the higher animals seems to be insufficiently accounted for, while the reduction processes remain imperfectly explained.

In the second chapter the author deals with the problem of heredity, and comes to the conclusion that at present the facts can only be elucidated by the light of mental, not material, processes. While inclining to the memory theories of Butler and Hering, he expresses himself also as favourable to an explanation assuming the succession of a series of complex chemical changes after the manner postulated by Delage or by J. T. Cunningham in his hormone theory of heredity. In the third chapter the author returns to the subject of brood formation and its relation to ordinary cell-division, and the various types of brood formation are briefly described. Chapter iv. first appeared under the title, "The Dual Force of the Dividing Cell," but in this work it has undergone much revision, and is headed "The New Force, Mitokinetism." In addition to the existence of a well-known physical force, and others the physical interpretation of which is uncertain (such as protoplasmic streaming), the author invokes the aid of a new force which he calls "Mitokinetism," besides assuming the existence of further forces which have no clear analogies either in physics or in biology. The whole chapter, though ingenious, is highly speculative, and consequently difficult to criticise in a short review.

In chapter v. Prof. Hartog returns to the subject of nuclear reduction, which is already touched upon in chapter iii. His view may be summarised in the statement that the process is a necessary consequence of cell fusion, instead of a preparation for it. The author appears to us to lay altogether undue stress upon the difference between the two theories. He points out that a reduction must take place somewhere, otherwise the number of chromosomes would go on increasing in geometrical progression. This is, of course, obvious, and since the reduction usually (though not invariably) takes place in the last division of gametogenesis, it appears to us legitimate to regard it as a preparation for zygotic union.

In the next chapter Prof. Hartog reverts to his views on fertilisation. He suggests that owing to the ambiguity of the term "fertilisation" it had better be replaced by "syngamy" when used in its strict morphological sense as the fusion of two cells or nuclei. He makes the interesting suggestion that the formation of the fertilisation membrane is the last relic of the time when the newly-formed zygote usually went into a resting condition.

In chapter vii. the author again gives the arguments in favour of the theory that acquired characters can be inherited, and in chapter vii. the case against a purely mechanistic interpretation of life is once more stated. Great stress is laid on the vital powers of readjustment and compensation under diverse conditions, and the possession of a spontaneity which is never possessed by machines, since these work for the mechanician, whereas the living organism works and adapts itself to its own racial needs.

The chapter on the biological writings of Samuel Butler is well worthy of perusal, and we feel indebted to Prof. Hartog for giving us a further insight into the fascinating personality of the author of "Erewhon." The last two chapters deal with education problems, and though not without interest, seem rather out of place in the present book. Though containing little that is new, the volume supplies a useful summary of the author's views on many subjects, and as such it forms a welcome addition to the "Progressive Science Series."

FRANCIS H. A. MARSHALL.

FOUR ZOOLOGICAL TEXT-BOOKS.

(1) *Elementary Biology: Animal and Human.* By J. E. Peabody and A. E. Hunt. Pp. xiv+212. New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1912.) Price 4s. 6d. net.

(2) *An Introduction to Zoology.* With Directions for Practical Work. (Invertebrates.) By Rosalie Lulham. With Illustrations by V. G. Sheffield. Pp. xv+457. (London: Macmillan and Co., Ltd., 1913.) Price 7s. 6d. net.

(3) *Teachers' Manual of Biology.* By Prof. M. A. Bigelow. Pp. ix+113. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1912.) Price 1s. 8d. net.

(4) *A Manual of Zoology.* By Prof. R. Hertwig. Third American from the ninth German edition. Translated and edited by Prof. J. S. Kingsley. Pp. xii+606. (New York: Henry Holt and Co., 1912.)

(1) THE lively book by Messrs. Peabody and Hunt strikes a modern educational note, for the primary emphasis is placed on *practical values*. It is intended as a guide to school-

teachers. Animals are discussed in order to throw light on the biology of human life, in order to help towards healthy living. Everyday functions get a prominent place; bees, mosquitoes, and flies come to the front; the discussion of birds and fishes leads on to the question of their conservation; the Protozoa are used to illumine man's cellular processes; bacteria receive much attention. Precise practical work is, of course, insisted on as a discipline, and many of the conventional tasks are included. But there are as many which have a fresh practical turn.

The lessons on everyday hygiene, on foods, and on the use of alcohol and tobacco seem to us very sound, and, in short, what we like about the whole book is its persistent endeavour to bring the biological instruction into direct touch with human life. There is no risk that the study of pure science will be in this way endangered, and there is every likelihood that the education of the young citizen will be immensely improved. The book is generously provided with interesting illustrations, many of them photographs.

For future editions we would make the suggestion that the authors do not attempt to cover quite so much ground. Thus the paragraph on the relatives of the earthworm would be much better deleted unless more can be said, and there are many other cases where this book would be improved by recognising the necessity for others. We should like to express our appreciation of the wholesome view that "no study of human biology should be allowed to leave in the mind of the student the idea that he is merely a chemical engine adapted only for the generation of a certain amount of physical energy."

(2) Miss Lulham is to be congratulated on the success of her "Introduction to Zoology," which fills a distinct gap. It introduces the student to the study of living creatures (Invertebrates only) with habits and habitats and interrelations, and it has been written from experience. It abounds in valuable practical hints. There is a convincing reality about the book, and a real feeling of the open air, two qualities which are enhanced by the unusually skilful and spirited figures which have been prepared by Miss Violet Sheffield. This introduction should be of great value to teachers of nature-study, to students working alone, and to those who wish to supplement their more analytic and anatomical work by some sound oecology.

Miss Lulham deals excellently with earthworm and starfish, pond-snail and prawn, but she is at her best when she comes to spiders and insects—to which much more than half the book is devoted. It will be a good thing for the study of natural history if this exceedingly educative "Introduction to Zoology" comes into widespread use, as it certainly ought to do. For it is unusually true to its excellent motto:—

Ἐν πᾶσι γὰρ τοῖς φυσικοῖς ἔνεστί τι θαυμαστόν.

(3) Prof. Bigelow's manual is really a sort of teacher's appendix to accompany "Applied Biology" and "Introduction to Biology," by Anna N. Bigelow and himself. He gives useful hints as to the best way of using the "Applied Biology" (without which this manual is of relatively little use), and advice in regard to material for practical work, methods, equipment, and literature. The orientation of the biological studies in relation to human life is a prominent feature in Prof. Bigelow's plan of instruction, and he is emphatic in regard to the indispensableness of the biological foundation. In regard to sex-hygiene, for instance, he says: "The most practicable step now possible in the world-wide movement for sex-education is the development of the full possibilities of the biological studies that touch the problems of reproduction."

(4) Prof. R. Hertwig's "Zoology" has passed through nine German editions and continues to be a favourite manual. It gives a general introduction to morphology and physiology and a systematic treatment of the various phyla, with special attention to particular types. Its virtues are general trustworthiness, clearness, and a judicious selection of essentials. Its deliberate defects are that it is too much pemmican and not very interesting, and that it says very little about the life of animals. Prof. Kingsley has prepared a revised American edition, especially adapted for American needs. It is to a considerable extent a new book, and it is a competent piece of work sure to be of great utility. It has been very carefully edited, and it includes not a few original figures. We cannot profess, however, to have any belief in the usefulness of the summaries of important facts given at the end of each phylum; many of the propositions are too terse to be true, and altogether they smack of the cram-book. J. A. T.

OUR BOOKSHELF.

Ueber einfache Pflanzenbasen und ihre Beziehungen zum Aufbau der Eiweissstoffe und Lecithine. By Dr. G. Trier. Pp. iv+117. (Berlin: Gebrüder Borntraeger, 1912.) Price 5·60 marks.

THIS work is a valuable contribution to plant chemistry by a well-known worker who, by his own researches, has considerably enlarged our knowledge in this special domain. He has found it possible to give a summary of recent work and theoretical views of a complex character which is extremely interesting but might easily have been made a very dull affair. After briefly formulating the simple bases and amino-acids occurring in plants, the author proceeds to discuss their relationships and the probable way in which they are actually built up in the plant. He develops a simple hypothesis by which amino-ethyl alcohol (which he himself recently isolated as a product of the hydrolysis of lecithin) and amino-acetic acid are formed from glycol and glycollic acid, and regards these substances as the simple bricks from which the complex lecithins and proteins are built up.

In this synthesis the primary stage is a Cannizzaro transformation of glycollic aldehyde to the corresponding alcohol and acid, which the author regards as effected by an enzyme mutase, citing evidence in support of this view. It may, however, be suggested that this action is a direct effect of light, as in the case of many similar changes recently studied. Some of the author's views as to the manner in which complex alkaloids, for example laudanosine in the *iso*quinoline group, are built up from a single aromatic amino-acid are ingenious and very probable. Interesting chapters in the work deal with such questions as the biological significance of the betaïnes, the occurrence of methylation in the plant, the nature of the phosphatides and lecithins and the synthesis of the purine bases within the plant.

Some of the author's remarks on p. 70 with reference to the non-production of nicotinic acid in nature would appear to need modification owing to the discovery, since the work was published, by Suzuki and Matsunaga of this acid in rice-bran; this acid has great significance as derived from a β amino-acid.

The work would be greatly improved by equipping it with an index. W. A. D.

La Sécrétion Pancréatique. By Emile F. Terroine. Pp. 133. (Paris: A. Hermann et Fils, 1913.) Price 5 francs.

This little book on the pancreas forms one of a series of biological monographs which are appearing under the direction of Prof. Dastre, of the Sorbonne. The first chapters treat the subject historically, and show by what slow steps the early knowledge of this important organ was obtained, and the important character of Claude Bernard's pioneer work.

The bulk of the book is, however, taken up with a discussion of modern views, which were initiated by Pawloff and elucidated by the great discovery made by Bayliss and Starling of the part played by a chemical stimulus in stirring up the organ to activity. This material, called secretin, is formed in the intestine, and reaches the pancreas by the blood-stream; so that the mechanism may be described as a "humoral reflex" as against the nervous reflex which was formerly supposed to exist. Secretin is not the only chemical messenger in the body; physiologists now are acquainted with a considerable number of these "hormones," and their discovery has created a great revolution in our conceptions of physiological and pathological processes.

What secretin is chemically is not yet known; the culmination of the work in the unravelling of its composition is reserved for the future.

The pancreas is full of interest because it also possesses an internal secretion, but that aspect of the subject is not treated in the present volume.

Dr. Terroine's book is to be thoroughly recommended to all who desire a clear account of recent progress and present doctrines concerning pancreatic activity. W. D. H.

The Posture of School Children: with its Home Hygiene and New Efficiency Methods for School Training. By Jessie H. Bancroft. Pp. xii+327. (New York: The Macmillan Co., 1913.) Price 6*s*. 6*d*. net.

It is beginning to be understood by parents and teachers that the complete education of children includes physical as well as mental training. The schools now no longer ignore the bodies of the pupils, but by medical inspection, graded physical exercises, which are remedial when necessary, and by careful sanitation, every effort is being made to make the children healthy in body as well as well trained mentally. In this useful undertaking doctors and teachers are cooperating, and one of the evidences of this joint endeavour is the appearance of numerous books intended to provide teachers with scientific and technical knowledge in an attractive form. The present volume is by the assistant-director of physical training in the public schools of New York City, and gives teachers guidance as to how to correct poor posture in the class-room, to prevent the various forms of curvature, and generally to assist normal growth.

Weather Signs and How to Read them. For Use at Sea. By W. Allingham. Pp. v+117. (Glasgow: James Brown and Son, 1912.) Price 2*s*. net.

The author states that this booklet is a compilation written as an aid to the rising generation of mariners. Considered from this viewpoint we have no hesitation in saying that it will be found interesting and useful. Weather is closely connected with barometric pressure, air and sea temperature, state of sky, &c.; but the predominant factor is pressure. Several chapters are devoted to these subjects and to the construction and use of synoptic and synchronous weather charts; the advantage to sailors of charts of monthly average barometric values is referred to specially. The author makes it quite clear that he holds decided opinions on several subjects, some of which differ from generally accepted views, *e.g.* in the chapter dealing with cloud forms and signs he considers it difficult to accept as a working hypothesis the supposed connection between clouds and dust particles, at least many leagues from land. He also urges simplification in cloud nomenclature, "for under the present involved divisions clouds are doubtless as often described erroneously as they are correctly." The supposed influence of the moon on weather is justly ridiculed, and the work is brought up to date by useful details of the advantages derived from radio-telegraphy.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Ionisation of Gases in the Schumann Region.

IN NATURE for June 12, Prof. Lyman discusses the evidence relating to the ionisation of air in the Schumann region, and concludes that ionisation of air can be produced by wave-lengths longer than λ1700.

The reasons why I consider that λ1350 is nearer to the limiting wave-length at which the ionisation of air sets in are as follows:—Using a discharge in hydrogen as a source of ultra-violet light and transmitting it through a quartz window (0·3 mm. thick), I was unable to get any ionisation in filtered air. I only obtained big effects with a certain piece of fluorite as the window. Another piece of fluorite which did not transmit the ionising light was transparent to about λ1350. Prof. Lyman's researches show that the hydrogen discharge emits very intense ultra-violet light distributed over a large number of wave-lengths between λ1200 and λ1600. Hence, with thin quartz, there was plenty of light available down to λ1450, but it produced no effect in my experiments. Similarly, wave-lengths down to about λ1350 produced no appreciable effects.

Lenard and Ramsauer used a very intense aluminium spark as their source of light, and found that the light from it transmitted through fluorite produced enormous ionisation in air. On the other hand, the light when passed through quartz did not produce any effect. According to Prof. Lyman's photographs, the wave-lengths available from the Al spark in air are a strong group of lines near λ1300, some weak lines near λ1500, and strong lines near λ1600 and λ1720–λ1800. Thin quartz cuts out the group λ1300, but allows the others to pass. We are not told explicitly whether the spark in Lenard and Ramsauer's researches was ever placed close to the quartz window to avoid air absorption; if so, the λ1500 and λ1600 groups would be effective. Fluorite, on the other hand, transmits the λ1300 group as well, and Prof. Lyman considers that the ionisation observed is probably due to these lines. He points out that my interpretation of his remarks, viz. that λ1300 represents the longest wave-lengths which are effective in ionising air, does not represent his views correctly. He considers that Bloch's recent work on the ionisation of air by a mercury lamp indicates that wave-lengths longer than λ1750 are effective.

I expect it will be agreed that by air we mean the usual mixture of oxygen and nitrogen free from all the more condensable gases. Lenard and Ramsauer found that ordinary dust-free air was certainly ionised by the light transmitted through quartz from their powerful source. It was only when very drastic methods of purification were adopted that the air was no longer ionised by the light transmitted through quartz. Although Bloch used dust-free air in his experiments, there is no evidence that he took the rigorous precautions which Lenard and Ramsauer assert are necessary to get rid of all the impurities which give rise to ionisation with comparatively long wave-lengths. In Bloch's arrangement, the mercury lamp was totally immersed in the stream of air, and consequently all the light emitted was available for ionisation, and hence the traces of impurities have every chance to be ionised. Bloch does not give any details, but I think the supports, insulated wires, &c., connected with the lamp inside the ionisation chamber might act as sources of impurities in Lenard and Ramsauer's sense.

If we consider the quantum theory of radiation to apply to ionisation of gases by light, then the energy available in the quantum, hn, must exceed the work V_0e required to separate an electron from a molecule. Palmer's experiments (*Phys. Rev.*, xxxii., p. 1, 1911) may perhaps be taken to indicate that the oxygen accounts for most of the ionisation in air. Taking the longest wave-length which ionises air to be λ1350, and $h=6{\cdot}55\times10^{-27}$, and $e=4{\cdot}65\times10^{-10}$, we get $V_0=9{\cdot}2$ volts. Now the ionising potential for oxygen according to Frank and Hertz is 9·0 volts. To maintain that λ1800 is nearer to the long wave-length limit implies that the quantum theory is not applicable to ionisation by light, for there is no reason to doubt the accuracy of the experiments of Frank and Hertz.

A. LL. HUGHES.

Cavendish Laboratory, Cambridge.

The Microtropometer.

MANY roads to progress in physical investigation are brought to an abrupt end through the lack of measuring instruments of sufficient sensitiveness. In the attempt to bridge over one of these disabling chasms the writer was led to the following device, which appears capable of some development. The principle can be illustrated with reference to a particular case. Suppose we have a Boys's radio-micrometer, which we will call the secondary instrument. If we project on to the vane of this an image of a Nernst lamp filament the beam of light from the mirror of the instrument may be deflected through one thousand scale divisions. Suppose now that the image of the filament is 1 mm. wide, and that it is projected by the mirror of another radio-micrometer, which we may call the primary one.

It is evident that a movement of this primary image through a distance of 1 mm. can produce a movement of the beam of light from the secondary instrument through 1000 mm. Hence, a movement of the image of the filament cast by the primary instrument through 0·001 mm. would give a deflection of about 1 mm., and a movement of the primary image through 1/1,000,000 mm. would move the secondary image through one-thousandth of a mm. If now the secondary instrument be made to throw a similar image on to a tertiary radio-micrometer, the motion will again be magnified one thousand times, so that an original movement of a millionth of a mm. produces a final movement of 1 mm. Evidently by increasing the number of instruments in arithmetical progression we increase the magnification in geometrical progression.

I have applied the method to two radio-micrometers with very satisfactory results. The principle, however, can be applied to any instrument in which a beam of light is used as an indicator—*e.g.* the primary instrument may be a galvanometer, an electrometer, a double-thread-suspension mirror, or a string-galvanometer (in the last case the image of the string taking the place of the image of the filament). The secondary instruments may be radio-micrometers, thermo-couples, bolometers, selenium cells, or other detectors of radiation. It will appear, therefore, that the principle is one capable of wide application to cases in which great sensitiveness of measurement is required—from wireless telegraphy to physiology. In fact, we may say that any existing instrument which uses light as an indicator can be made more sensitive.

Practical difficulties arise from the impossibility of obtaining any instrument with absolutely constant zero; moreover, fluctuations in the intensity of the energy stream from the source of radiation, represented by the Nernst filament, would cause trouble where great magnifications were desired. This last difficulty might to some extent be surmounted by using as a secondary instrument the two strips of a bolometer, so that fluctuations would make proportional changes in both strips, whereas a deflection gives a differential effect. Experiments, however, on the application of the principle are in progress.

G. A. SHAKESPEAR.

The University, Birmingham, June 24.

Wireless Antennæ.

IN recent issues of NATURE several correspondents, in referring to the fact that a metal bedstead or a few wires stretched a few feet above the ground will make a wireless antenna, have overlooked a most important point, viz. that with such an antenna the ordinary methods of tuning are quite useless.

A piece of wire netting suspended a few feet above the ground makes a most effective aërial, and enables one to receive loud signals from long-distance stations, but signals from Eiffel Tower, C'eethorpes, &c., will all be mixed up, and the ordinary tuner will not separate them effectively. It seems to me that this proves that the usual theory of the waves travelling through space in the air above the earth's surface and being cut by the aërial does not *wholly* account for the facts.

Wireless signals that are feeble when the surface of the earth is dry, becoming much stronger after rain, and the well-known fact that these waves travel much better over sea than over land, all seem to indicate that the aërial waves are *at least* supplemented by waves that travel along the surface of the earth, and that the wire netting, bedsteads, &c., act as counter capacities, allowing these waves to flow from the earth through the receiver. The capacity of a small piece of wire netting near the ground is much greater than a very extensive aërial high up.

Canterbury. A. LANDER.

The Occurrence of "Anomalocera pattersoni," Temp., in Mounts Bay.

IT is stated by Mr. L. H. Gough ("Report of the Plankton of the English Channel," 1903), that the copepod *Anomalocera pattersoni*, R. Temp., may generally be regarded as an oceanic species. Gough's observations tended to show that Gran was correct in assuming this to be the case, although Cleve considered the species to be neritic. Sars, in his "Crustacea of Norway," speaks of the occurrence of this copepod "off the south and west coasts of Norway, generally congregated in great shoals," but throughout the reports published in connection with the international fishery investigations, no record occurs of its similar abundant occurrence in the English Channel.

It is interesting to record, therefore, that during an intensive survey of the planktological conditions of Mounts Bay, performed from the s.y. *Mera* on June 2, an extensive shoal of the species was met with at the surface on a position 50° 4′ 20″ N. × 5° 27′ 55″ W. The product of a five minutes' haul with the coarse tow-net amounted to 34·75 c.c. of material, of which at least three-fourths was made up of Anomalocera, both in its adult and developmental stages. The visitation of this copepod, in association with several other oceanic forms of phyto- and zooplankton, to a comparatively close inshore position may possibly serve as an indication of somewhat abnormal hydrographical conditions, but unfortunately no physical observations are yet to hand to enable a comparison to be formed.

HAROLD SWITHINBANK.
G. E. BULLEN.

S.y. *Mera*, R.Y.S.

Artificial Hiss.

LORD RAYLEIGH'S "sound more like an *f* than an *s*" (NATURE, May 29, p. 319) is due, according to Köhler's observations (*Zeits. f. Psych.*, 64, p. 93), to a slightly too high pitch. A Galton whistle, set for a tone of 8400 v.d., will give a pure *s*.

E. B. TITCHENER.

The Psychological Laboratory, Cornell University, Ithaca, N.Y.

THE BICENTENARY OF THE BOTANIC GARDEN OF ST. PETERSBURG.

THE bicentenary of the foundation of the Imperial Botanic Garden at St. Petersburg was celebrated with unusual pomp on June 24. The history of the garden, its share in the botanical exploration of north, central, and east Asia, and the practical completion of its reorganisation on modern and truly liberal lines justified the festive character of the proceedings. They were initiated on the eve of the jubilee by a special service, attended by the staff of the garden, in the Peter-Paul's Cathedral, and the laying down of a wreath of roses at the tomb of Peter the Great, the founder of the garden, and on the following morning by a little shower of honours for the director and his staff.

The principal ceremony took place in the afternoon in a building attached to the old herbarium, in the presence of a brilliant gathering, including the Princes Peter and Alexander of Oldenburg, Prince Gagarin, representing Princess Eugenia of Oldenburg, under whose patronage the garden is placed, the Ministers of Agriculture, Commerce, Justice, Public Cults, and Marine, and other prominent officials, and a large number of delegates from the Russian academies, universities, botanic gardens, and kindred institutions, and from foreign countries. The solemn meeting was preceded by a Te Deum, and formally opened by the Minister of Agriculture, Mr. Kriwoshein. A rescript from the Emperor was read, in which it was announced that the garden would henceforth be known as the Imperial Botanic Garden of Peter the Great. Then followed an eloquent address by the director of the garden, Prof. A. Fischer von Waldheim, in which he traced the history of the garden and its present organisation and object; the reception of the delegates, and the presentation of medals and souvenirs commemorating the jubilee.

The next day was reserved for the inspection of the garden, museum, and laboratories, and in the afternoon a visit to Peterhof, where the guests experienced an exceptionally cordial reception. In the evening the festivities came to a conclusion with a gala performance in the opera house in the Narodni Dom.

Most of the botanical gardens and many of the other botanical institutions sent their congratulations, whilst Bulgaria, Denmark, England (Kew and Chelsea), Germany, and Sweden were represented by delegates.

The garden was founded by Peter the Great about 1713, so that it is practically as old as the capital itself. The site selected for it was on one of the islands in the Neva, low-lying, boggy land, and the object the cultivation of medicinal plants mainly for the army and navy. Hence it was called the Apothecaries' Garden, and the island itself Apothecaries' Island. Among those attached to it were Siegesbeck and Falk, well known from their connection with Linnæus. In 1823, however, the garden was put on an entirely new footing by Alexander I., who raised it to the rank of a scientific institution under the title Imperial Botanic Garden. His first director was F. E. L. Fischer (1823–1850), who had already risen into notice through his successful management of the famous garden at Gorenki, near Moscow. Thanks to his wide connections with botanists and botanical gardens outside of Russia—he was *inter alia* a personal friend and life-long correspondent of William Hooker—and his active encouragement of botanical research in the Russian Empire, he was able in a short time to build up a very large collection of living and dried plants.

After Fischer's retirement in 1850 the history of the garden was of a somewhat varied character. From 1830 to 1863 it was under the ministry of the Imperial Court, and there was at times a danger of its becoming reduced to a nursery for table decorations for the Court; but when, in 1863, it was transferred to the Ministry of Agriculture it was definitely saved from that fate, and it soon regained, and, in fact, eventually exceeded, its old reputation under the double directorship of Trautvetter and Eduard Regel, and afterwards under Regel's undivided control. If Regel, by training and taste, inclined more towards horticulture and a lighter conception of the aims of phytography, his collaborator and colleague, the scholarly *botanicus primarius* and academician C. Maximowicz, excelled through the rare thoroughness and comprehensiveness of his taxonomic work. Both were fertile writers, and the exploration of Turkestan, Siberia, and Central Asia, which in those days proceeded with such marvellous energy, found in them most able interpreters. Maximowicz died in 1890, and Regel followed him soon.

After the short directorship of Batalin, the present director, A. Fischer von Waldheim, until then professor of botany in the University of Warsaw, was appointed in 1897. With him a new era began. It has so far resulted in the comprehensive reorganisation of the establishment and its transformation into a great national institution for the study of pure and applied botany, comparable to the institutes of Kew and Dahlem, although less universal in its range in so far as it is expected to serve in the first place the special interests of the Russian Empire. To quote from the official French guide, published on the occasion of the jubilee, the Imperial Botanic Garden of Peter the Great is intended for the study of the plants which form the flora of Russia and the adjoining parts of Asia, of economic botany, plant anatomy and physiology, of plant parasites and the means to fight them, for seed control, and the cultivation and testing of plants of practical importance for agriculture, horticulture, industries, and medicine, and finally for the popularisation of the botanical sciences.

The garden covers an area of fifty acres, of which thirty go to form what is called the "Park," or garden proper, whilst 7·5 acres are under glass and more than twelve are occupied by buildings. The scientific staff consists of the director, three chief botanists, one chief conservator, five conservators, two assistant conservators, and one librarian. For purely administrative purposes the director has at his disposal a secretary, a cashier, an "intendant," a clerk, and two assistant clerks, these officials forming the "chancery," or director's office. The garden work is superintended by two head gardeners, with two assistants and thirty-five gardeners. There are about fifty "fixed" labourers of both sexes, and about as many artisans, guards, porters, and inferior hands. The Botanic Garden comprises, beside the "Park" and the glasshouses, the following distinct departments:—the herbarium, the museum, the library, the zoological laboratory, the seed control station, the phytopathological station, the "seminarium," or depôt for seeds, gathered in the garden or sent in by travellers and explorers, or received in exchange or by purchase, the "chancery," and the school for gardening.

A splendid new building for the herbarium and library has just been completed, whilst another for the museum collections, and on a similarly large scale, is to be commenced next year. The garden has also its own electric station and electric engineer. It is not possible here to enter into any details concerning those departments, but it may be mentioned that the herbarium and the library, both of which are among the richest in the world, will no doubt remain for long the most valuable portion of the establishment and the centre of its activity. The herbarium is the recipient of the collections of the numerous expeditions organised by the Colonisation Commission (since 1908), and devoted to a grandly planned botanical survey of the Asiatic possessions of the empire. As a similar survey is in course for Russia proper, a collection is building up probably quite unique in its completeness and representative character. A considerable addition to the staff is contemplated, and concurrently an increase of the budget of the garden to 160,000-170,000 roubles (16,000*l*.–17,000*l*.).

This brief account would be incomplete without a word of admiration for the liberal and far-seeing spirit in which the jubilee was conceived, and the whole-hearted sympathies with which everyone, from the representatives of the Imperial Family and the Government down to the last delegate, joined in the recognition of the national importance of the work done by the establishment, and still more of the work which is to go forth from it in the future. There was not much boasting, but a joyful expectation of new and greater achievements.

O. S.

THE DAWN OF WESTERN CIVILISATION.[1]

THE volume before us is the final contribution to our knowledge of the Baoussé-Roussé Caves. It may be recalled that volumes dealing with the history, the geology, the palæontology, and the anthropology of the deposits in these caves have been reviewed already in NATURE.[2] To complete the picture it was necessary that we should know the archæology, and this the volume now under notice supplies. From the nature of the subject with which it deals it can be well understood that the volume is in no way inferior in interest or importance to those which have preceded it.

The deposits in the caves are, from the viewpoint of the archæologist, assignable to the Mid-Moustier, the Superior Moustier, and the Mid-Aurignac periods; neither the first nor the last phase of the Aurignac culture is represented. The caves therefore afford evidence of having been occupied at two distinct periods, with a considerable interval of unknown length during which they were not occupied by man.

As to the first or Moustier period, it is significant that the worked stones are of an undoubted Moustier pattern, but yet they are not all associated with the remains of a Moustier fauna. In the Grotte du Prince, for example, five foyers have been distinguished, the stones from which only differ in the character of the material which was used. Of these five foyers, however, the two lowest are associated with the remains of animals which lived during the Chelles period, species which denoted a warm climate—the hippopotamus, the *Rhinoceros Merckii*, the *Elephas antiquus*; the third foyer was associated with a mixed Chelles and Moustier fauna, whereas the two upper foyers only yielded remains of the latter fauna. It thus results that in this cave we have a Moustier culture contemporaneous in part with a Chelles fauna, a contradiction which provokes the question whether in such a case it is more justifiable to attach importance to the industrial stage reached by man in his development or to the associated fauna, suggestive as it is of climatic and geographical conditions. Although much might be said in favour of either view, we agree with M. Cartailhac that, in this instance at least, it is safer to base our conclusions on the character of the implements, particularly as we should expect the Chelles fauna—a fauna of a warm climate—to linger longest in the south of Europe, where it might well be contemporary with the Moustier fauna in a more northern latitude.

As to the second or Aurignac period, we are glad to find M. Cartailhac availing himself of the opportunity afforded him to give in a separate chapter an excellent résumé of the history and of our knowledge of the Aurignac phase from the days of Lartet and Gabriel de Mortillet to the present day when, thanks to the brilliant work of Abbé Breuil, we may consider the Aurignac period as firmly and permanently established. The particular interest in the period lies in the fact that, owing to the greater variety of the tools, the presence of ornament, and the first definite appear-

FIG. 1.—Necklac.s of the Aurignac period.

[1] "Les Grottes de Grimaldi (Baoussé-Roussé)." Tome ii., Fascicule ii. Archéologie. By Emile Cartailhac. Pp. v+215–324+plates xii–xxiii. (Imprimerie de Monaco, 1912.)

[2] October 10, 1907; July 27, 1911.

ance of grave furniture, we are permitted a more intimate insight into the life and habits of Palæolithic man.

It is an interesting yet readily intelligible reflection that, although the mass of the deposits postulates a long period during which the layers gradually accumulated, although the fauna changed considerably during that time, yet the same weapons are found in the upper as in the lower beds. The explanation, of course, is that at all periods the dwellers in the caves were hunters, and the same weapons were required, although the animals which they hunted might and actually did differ. Another conclusion to which we can, we think, with reason arrive is that there was no very great lapse of time between the end of the Moustier period and the middle of the Aurignac period; in other words, the first of the divisions into which this last period has been divided does not, at Grimaldi at any rate, appear to have been of sufficient length to have made its presence felt.

It is to the middle of the Aurignac period that the graves, of which there were no fewer than thirteen, should be ascribed. Further, the graves were clearly of the same date, judged by the character of the associated relics, although it is curious to find the methods of burial were not identical; for example, the dead were in some cases disposed at length, at other times they were found in contracted positions.

Like its predecessors, the volume is perfectly produced and illustrated. An admirable bibliography concludes the volume, and the fact that the literature dealing with these caves covers a period stretching from 1786 to 1912 is perhaps sufficient evidence of their infinite power to stimulate interest and investigation.

The text of the volume at present under review, while as strictly scientific and accurate as possible, is warmed by many sympathetic references, M. Cartailhac having, from his lifelong labours in this field of archæology, acquired no little affection for these long-forgotten followers of the chase, no little insight into their habits and life.

WILLIAM WRIGHT.

THE DIVINING ROD.

WITHIN the last few years many experiments have been performed in various countries to test the claims of water diviners, and among those who have published papers on the subject are Graf Karl von Klinckowstroem, of Munich, and Dr. Armand Viré, director of the Laboratory for Underground Biology in Paris. A series of experiments at Guildford has also been organised by the editor of *The Sanitary Record and Municipal Engineering*, under the auspices of a number of scientific men, including Prof. Henry Adams, Dr. Herbert Lapworth, and Dr. Samuel Rideal.

Graf von Klinckowstroem, in a paper published in parts 1, 2, and 3 of the *Zeitschrift des Vereines der Gas- und Wasserfachmänner in Oesterreich-Ungarn* for 1913, gives, in the first instance, an account of certain supposed successes in water-finding, which Dr. Achille Poskin, of Spa, has gathered together from various sources. These are not very interesting, as the observations do not appear to have been controlled by impartial witnesses possessing some knowledge of scientific methods.

But Dr. Poskin also includes an account of five experiments undertaken by him, in which the diviners indicated places where water was found. Dr. Poskin believes that he himself possesses the power of detecting water by means of the divining rod. In any case, it is quite certain that "dowsers" are frequently successful in indicating points where water is subsequently found; the real question is, whether these indications are produced by anything outside themselves, or whether they are purely subjective.

In the same paper Graf von Klinckowstroem has translated into German a paper describing my own experiments, accounts of which were published in *The Times* and in *The Journal of the Royal Society of Arts* in 1911. He admits that the experiments were performed with all reasonable care, and without any prejudice, but he describes them, using stronger language than I did, as a fiasco for the diviners who were tested, and then gives a number of possible reasons why the experiments may have failed. He does not give enough weight to the fact that in every case the experiments were conducted under conditions which the dowser in question thought reasonable, and were directed to test powers which he alleged he possessed. This seems to be the only reasonable way of attacking the question from a scientific point of view; it is not for the investigator to say what the dowser can do, or under what conditions he can do it, but when the dowser has stated what his powers are, to arrange an experiment which shall test the alleged powers.

M. Armand Viré (*La Nature*, April 19, pp. 332–338) has conducted a series of experiments in order to ascertain whether the diviners could determine the existence of underground cavities which did not contain water; the results given by M. Viré include a considerable number of "successes," but he passes over too lightly the cases in which the indications given by the diviners are inaccurate. It will be interesting to await the result of an experiment which he proposes to undertake later, in order to discover the shape and extent of caves or grottoes the existence of which has not yet been proved, and the plans for which will only be prepared after the diviner's plans have been reduced to paper.

The series of experiments recently performed in the neighbourhood of Guildford have now been completed, and the committee of investigation has published its report. The members point out that, while there appeared to be some evidence that certain persons may be sensitive to underground water, their sensitiveness "is not sufficiently definite and trustworthy to be of much practical value." They also allude to the lack of agreement with each other which the results show, and they take this as evidence that the movements of the rod are due to subjective and not to objective causes. These are precisely the opinions formed as a result of my own series of experiments; and it may still be assumed that no adequate evidence has been produced in favour of the existence of something acting outside the dowser which causes his twig or other indicator to move when it is over water.

In *La Nature* for May 10 (p. 379), M. Gustave Le Bon has published an article recording the success of certain diviners in discovering the metals contained in five envelopes (viz., aluminium, copper, silver, lead, and zinc); but, as he admits, the method of experiment was not satisfactory, since he thinks he may unintentionally have given signs of approval while the diviners consulted together as to what metals were contained in the envelopes, and since the method of procedure involved the displacement of the envelopes by the diviners, thus giving them an opportunity of forming an opinion based on the different weights, &c., of the metals. He also mentions that M. Coupaux, who performed similar experiments, only had one success out of five, but that the diviners objected to these experiments because the metals were enclosed in glass tubes, and, as they allege, the glass prevents their feeling the influence of the metals.

On the whole, M. Le Bon is of opinion that there is enough evidence to warrant further examination into the claims of diviners; he thinks, however, that the commission appointed by the Académie des Sciences to examine into the question so far as it relates to the discovering of springs ought to do more, and he asks that this commission may also undertake experiments similar to those which he has performed. My own experiments in this direction went to show that the experienced diviners with whom they were tried were not able to discover gold or silver by means of their rods; for though one diviner scored a remarkable success in a single instance, he was absolutely wrong in the other experiments of the same kind which he performed. Nevertheless, this single success (fortuitous as I believe) confirmed an intelligent friend who witnessed it in his belief that the powers of the diviners are real!

J. Wertheimer.

DR. P. L. SCLATER, F.R.S.

Zoologists throughout the world will join with their English brethren in lamenting the death on June 27—albeit at the advanced age of eighty-four—of Dr. Phillip Lutley Sclater, F.R.S. The second son of the late Mr. W. L. Sclater, of Hoddington House, Hants, the deceased naturalist was born in 1829, and received his education first at Winchester and subsequently at Corpus Christi College, Oxford, where he graduated first class in mathematics, and subsequently became honorary fellow of his college. In 1855 he was called to the Bar as a member of Lincoln's Inn, and in 1875 he acted as private secretary to his brother, the Hon. G. Sclater-Booth (afterwards Lord Basing), when President of the Local Government Board. So early as 1850 he had commenced to write on zoology. Soon after his call to the Bar he devoted himself mainly to natural history, and he was elected secretary to the Zoological Society of London in 1859, which important post he retained till 1902, when advancing years led to his voluntary resignation.

During the greater part of that prolonged period Dr. Sclater was the ruling spirit of the society, and it was to his organising capacity and untiring energy that the menagerie in Regent's Park attained the pre-eminent position it occupied, both as a zoological centre and a place of popular resort, at the time of his retirement. He was also editor of the society's numerous publications, to which he communicated an extraordinary number of valuable papers and memoirs; and it was during his term of office that the Proceedings became entitled to rank as one of the very foremost zoological journals in the world.

But the executive and scientific work connected with the Zoological Society by no means sufficed to absorb all the energies of its secretary, for in 1859 he became editor of the *Ibis*, a then newly started ornithological journal, and held that post until 1865, to resume it, in conjunction with the late Mr. Howard Saunders, in 1883, and to hold it, either alone or associated with others, throughout the rest of his working career. Dr. Sclater was also one of the founders of the British Ornithologists' Union, of which body he long occupied the presidential chair. Of even more importance, perhaps, was Dr. Sclater's share in the foundation and maintenance of the "Zoological Record," as without that wonderful work of reference zoology at the present day would be an absolute impossibility.

Dr. Sclater was also one of the pioneers—if not the actual founder—of the modern science of geographical distribution; and it is to him that we owe such now familiar terms as "Palæarctic" and "Nearctic," which are excellent examples of the classic form of scientific nomenclature in which he delighted.

The prodigious amount of scientific work, more especially in ornithology, produced by Dr. Sclater may be inferred from the fact that a record of his career published some years ago contains entries of something like 1200 different papers and memoirs. From a popular point of view one of the most attractive works with which he was connected was Wolf's "Zoological Sketches," while his monographs of various groups of South American birds are models of their kind.

For the greater part of his long life Sclater was a man of intense activity and energy, and only during the last few years did he show signs of failing health. Injuries received in a carriage accident a few weeks ago hastened the termination of a long life devoted to the advancement of zoological science.

R. L.

NOTES.

THE window in Westminster Abbey in memory of Lord Kelvin will be unveiled at the 3 p.m. service of the Abbey on July 15.

WE are informed that the following have been elected life honorary members of the Geological Society of South Africa:—Dr. J. S. Flett, F.R.S., assistant director, Geological Survey of Great Britain; Dr. A. Lacroix, professor of mineralogy, Natural History Museum, Paris; and Prof. E. Weinschenk, Alte Akademie, Munich, Bavaria.

THE death is reported, in his seventy-seventh year, of Mr. W. A. Conklin, director of the zoological department of the Central Park, New York, from 1865 to 1898. After the latter date he was engaged in importing wild animals into the United States. From 1878 to 1893 he edited *The Journal of Comparative Medicine and Veterinary Archives.*

IN the article on the Birmingham meeting of the British Association that appeared in NATURE on June 12 it was stated that an organised programme of the field work in connection with the Geological Section had been prepared by Dr. T. Groom, with the supervision of Prof. Lapworth. We now understand that this is not the case. The excursions in connection with the Geological Section have been organised by Prof. Lapworth, and not by Dr. Groom.

AN earthquake occurred in southern Italy shortly before 10 a.m. on June 28, strong enough to damage buildings in several villages of the province of Cosenza. No lives were lost, though more than twenty persons were injured by falling masonry at Rogiano Gravina. The shock was felt at Messina and Naples, which are respectively about ninety and 150 miles from the epicentre. The province of Cosenza includes one of the more pronounced seismic regions of Calabria, in which originated the severe earthquake of February 12, 1854, and, in part, the still more destructive shock of September 8, 1905.

It is proposed to commemorate in 1914 the seventh centenary of Roger Bacon's birth (1214) by erecting a statue (by Mr. Hope Pinker) in his honour in the Natural History Museum at Oxford, and by raising a fund for the publication of his works. An influential committee, with Sir Archibald Geikie, K.C.B., P.R.S., as chairman of the executive, has been formed to carry these purposes into effect. Roger Bacon was the champion of experimental science and the advocate of positive knowledge at a time when logic reigned supreme; and we are glad that his important place in the history of science is to be made more widely known. The committee proposes:—(1) To hold a Roger Bacon commemoration at Oxford in July, 1914, when the statue will be unveiled, and addresses will be given by distinguished scholars; (2) to issue a memorial volume of essays dealing with various aspects of Roger Bacon's work, written by specialists in the various subjects; (3) to arrange for the editing and printing of Roger Bacon's writings, so far as funds will allow. The first volume (now in the press) will contain his unpublished treatise and commentary on the pseudo-Aristotelian "Secretum Secretorum," edited by Mr. Robert Steele. The second volume will probably contain the medical treatises, an edition of which is being prepared by Dr. E. T. Withington and Mr. A. G. Little. The committee points out that other volumes should contain a complete edition of the "Opus Tertium" (fragments of which were printed in 1859, 1909, and 1912); the "Quaestiones" on Aristotle's physics and metaphysics, and on the "De Plantis"; the "Communia Mathematicae," and perhaps the "Computus Naturalium; while new and critical editions of the "Opus Majus," of the fragmentary "Opus Minus," and of the less important "De Naturis Metallorum" and "Tractatus Trium Verborum" are desirable. A general committee (of which the Chancellor of the University of Oxford has consented to be hon. president) is being formed, consisting both of collaborators in the editorial work and of subscribers. Subscriptions in aid of the foregoing objects should be sent to the secretary of the executive committee, Colonel Hime, 20 West Park Road, Kew.

THE Historical Medical Museum now open in Wigmore Street, Mr. H. S. Wellcome's magnificent collection, is one of the most interesting sights of London. All ages and all countries have been ransacked to make it complete; we go from Babylon to here, and from the dawn of the art of healing to now. Medicine, like man himself, is of lowly origin; we have to keep reminding ourselves that evolution is creative wisdom, not blind force, alike in the one case and in the other. On the threshold of the museum we are met by hideous idols, and all the ugliness of witch-doctors and devil-dancers; and there, in the midst of all these savageries, is an exquisite model of the Wellcome Floating Tropical Research Laboratory, and a long array of the latest and rarest germs under microscopes. We stand in the hall of statuary, and look past a most unspeakable "ancient Mexican deity of healing" to Apollo and Æsculapius; or we study the weaved-up follies of charms, amulets, and talismans, until we find—it is an error of judgment—a crucifix among them. The museum is a fine place to wonder and think in—so many hundreds of instruments now discarded and labelled and put under glass; so many appliances become curiosities; so many ways of healing deserted. Then comes the dismal thought that a hundred years hence all our present apparatus will likewise be useless:—

> "It makes me mad, to see what men shall do—
> And we in our graves—"

Truly, one must take a pinch of philosophy, and a pinch of faith, to keep one's head in this museum. With these, it is possible to receive such a history lesson as will not be forgotten for many years.

A STANDING Committee of the House of Commons on June 26 discussed a Bill to prohibit experiments upon dogs. The chief operative clause in the Bill proposes to enact that "from and after the passing of this Act it shall be unlawful to perform any experiment of a nature causing or likely to cause pain or disease to any dog for any purpose whatsoever, either with or without anæsthetics, and no person or place shall be licensed for the purpose of performing any such experiments." Strenuous opposition was offered to the Bill on behalf of medical science. An amendment was carried postponing the coming into operation of the Act until January 1, 1914. Sir F. Banbury, who has charge of the Bill, agreed to consider the incorporation of an amendment to leave out from "anæsthetics" to the end of the clause and insert "except on such certificate being given as is mentioned in the Cruelty to Animals Act, 1876, that the object of the experiment will be necessarily frustrated unless it be performed on a dog, and that no other animal is available for such experiment." The effect of that would be to bring the dog within section 5 of the Cruelty to Animals Act, and it is in harmony with the majority report of the Royal Commission. The Committee is to resume the consideration of the Bill as we go to press.

Yale University proposes to hold a centenary celebration next November in commemoration of the geological work of James D. Dana. A series of lectures will be given which will be published later in a Dana memorial volume on problems of American geology. The lectures will be given on the Silliman Foundation, and the dates will be announced after the opening of the next academic year. We learn from *Science* that the lecturers and their respective subjects are as follows:—Introduction: The geology of James Dwight Dana, Prof. W. N. Rice, Wesleyan University. (1) Problems of the Canadian Shield: The Archeozoic and its problems, Prof. F. D. Adams, McGill University; the Proterozoic and its problems, Prof. A. P. Coleman, University of Toronto. (2) Problems of the Cordilleras: The Cambrian and its problems, Dr. C. D. Walcott, Smithsonian Institution; the igneous geology and its problems, Prof. W. Lindgren, Massachusetts Institute of Technology; the Tertiary structural evolution and its problems, Dr. F. L. Ransome, United States Geological Survey; the Tertiary sedimentary record and its problems, Dr. W. D. Matthew, American Museum of Natural History.

The National Geographic Magazine for April takes the form of an admirably illustrated monograph, describing the results of the Yale University Expedition to Peru in 1912, under the charge of Prof. H. Bingham. The most important result was the discovery of the great deserted city, Machu Pichu, on the Urubamba River, north-west of Cuzco. The national legends indicate that the original home of the Incas was at a place called Tampu Tocco, "the temporary abode with windows," which has now been identified with Machu Pichu, the principal temple of which contains three remarkable windows, through which the three Inca groups are said to have emigrated. The inaccessible position of the city rendered it possible for the Incas to conceal its existence from the Spaniards. The wonderful megalithic masonry constructed in the premetallic age, the strange temples in which the cult of the sun and auguries from sacred serpents seem to have been practised, the remarkable burial caves in which the corpses were interred in a crouched posture, the bronzes and pottery, are all described in Prof. Bingham's report. It constitutes a record of important archæological discoveries conducted in a most inaccessible region under extreme difficulties. The investigation of this district opens out a new chapter in the ancient history of Peru.

In Bankfield Museum Notes, second series, No. 2, the keeper, Mr. H. Ling Roth, issues another of his useful monographs on primitive industries—"Ancient Greek and Egyptian Looms." After an investigation of the facts, supplemented by illustrations and comments derived from a wide survey of the evidence, he comes to the following conclusion. The ancient Egyptians had two forms of loom: the earlier or horizontal form, still surviving in a modified form in Egypt and Seistan; second, the vertical, a later but not universally later form. In the Greek loom the type was upright, the warp threads being kept taut by weights, and similar to the form in central and northern Europe. It probably was provided with a heddle, but this is not certain: a spool was used; the weavers were women, and the weft was beaten upwards or away from the weaver. There seems to be no connection between the Greek and Egyptian types. But in form of looms used by the two peoples the Egyptians were considerably in advance of the Greeks. An interesting part of the monograph is the experiments made by modern skilled weavers to work these primitive machines.

The introduction of the string galvanometer and its improvement by Prof. Einthoven, of Leyden, have furnished physicians with a new weapon in the exploration of the heart's activity. It is now possible by the use of this sensitive instrument to record photographically the electrical changes which accompany cardiac activity, and the variations these undergo in heart disease furnish the observer with absolutely sure signs of the character of the ailment. The older methods of observation (the stethoscope, &c.) will still remain in use, for, unfortunately, the outfit for obtaining the electro-cardiogram cannot be placed either in the waistcoat pocket or even in a top-hat. It demands a special laboratory and an expensive installation. Electro-cardiography will therefore still remain a method limited to large institutions or to a few specialists. We have received from the Cambridge Scientific Instrument Co., of Cambridge, an interesting catalogue of the apparatus they supply for the purpose, which contains instructions as to the way to use it. Specifications for complete outfits are given, but the cheapest is more than 200*l*.

The current number of *The Quarterly Journal of Microscopical Science* (vol. lix, part 1) bears striking testimony to the excellent work done by the Glasgow school of embryologists, under the leadership of Prof. Graham Kerr. Miss Monica Taylor contributes a very valuable account of the development of the remarkable South American eel-like fish *Symbranchus marmoratus*, with some beautiful illustrations. Nothing has hitherto been known of the development of these remarkable fishes, but abundant material was collected by Dr. Agar in the Gran Chaco in 1907, upon which Miss Taylor's work is based. There are no fins in the adult fish, but the larva has well-developed pectorals, which are used mainly as respiratory organs and drop off bodily when the perfect branchial respiration is established. Miss Jane I. Robertson, from the same school, contributes a useful memoir on the development of the heart and vascular system of *Lepidosiren paradoxa*, which will be welcomed by comparative anatomists. The University of London is also to the fore in embryological research, as witnessed by a memoir on the reproductive cycle in the marsupial *Dasyurus viverrinus*, by Prof. J. P. Hill and Dr. C. H. O'Donoghue.

The variations in the common fresh-water nerite (*Neritina fluviatilis*), which are illustrated by a coloured plate, form the subject of a paper by Dr. R. Hilbert in the 34 *Bericht Westpreuss. Bot.-Zool. Vereins*. These variations, which are very marked, are associated not only with locality, but also with environment, which is likewise extremely variable; some of these molluscs living in water with strong springs, some in small, slow brooks, others in rapid streams or large rivers, and yet others in calcareous, brackish, and even thermal waters. These different stations and physical conditions constitute, in the author's opinion, the starting points of the numerous variations in form and colour so characteristic of the species.

After a considerable, but unavoidable, delay, the concluding portion of the late Mr. J. E. Robson's "Catalogue of the Lepidoptera of Northumberland and Durham" has been published in the Natural History Transactions of Northumberland, Durham, and Newcastle-upon-Tyne, vol. xv., part 2, this issue forming the completion of the old series. In an introduction to the minute moths of the group Tineina, which forms the subject of this part of the work, the author remarks that two or three species of that group which occur in the area under consideration are unknown elsewhere in the British Isles. "One insect, *Acrolepia vetuletella*, has not been recorded elsewhere than in the county of Durham, though I believe a solitary example was taken . . . at Richmond, in Yorkshire. Another, *Lithocolletis insignitella*, . . . has not been taken in England except between Hartlepool and Castle Eden, where it occurs in enormous numbers."

The *Bulletin International* of the Academy of Sciences of Bohemia (Česka Akademie Císaře Františka Josefa) for 1912 brings the progress of scientific work in Bohemia before a wide circle that must remain ignorant of the national language. The papers in this volume are in one case in French, and in all other cases in German, and the majority deal with mathematical or geological inquiries. B. Němec continues his studies on fungi, and L. Pračka provides two papers on variable stars. V. Rosický has made a complete examination of seventeen crystals of miargyrite ($Ag_2S.Sb_2S_3$), resulting in the measurement of twenty-three new forms from the Bohemian specimens alone. F. Slavík directs attention to the formation of aragonite at ordinary temperatures in mine-waters at Příbram. B. Ježek describes a new rhombic thallium mineral, orbaite, from Macedonia, based on the acid HAs_3S_5, with the composition $TlAs_2SbS_5$. A. Hofmann and F. Slavík report on gold and on telluride ores in quartz-veins near the Bavarian border, where mining was carried on so far back as the thirteenth century. R. Sokol has studied the terraces of the Elbe valley, and J. Woldřich goes beyond Bohemia to the Carpathians above Dobschau, where, in examining mountain structure, he has found interesting traces of a flora that is probably of Devonian age.

Vol. xlvii. of the *Nouveaux Mémoires de la Société Helvétique des Sciences Naturelles* is occupied by two important papers. E. Ganz writes on the stratigraphy of the Middle Cretaceous of the northern Alps of Switzerland, beginning with the "Schrattenkalk" (Barrémian), and ending with the Cenomanian "Seewerkalk." Many geologists will remember the fine cliff-sections of these series in the Säntis area, and the contrast between the scenery presented by them and that on the margin of our Surrey Downs. On p. 140 the author reminds us of the sandy character of the lower Albian and of the clays of the upper Albian in both the Alpine foothills and the south of England. He adopts "Gault" as a stratigraphical and not a lithological term, embracing the Albian and the Gargasian series when these cannot be divided on a map. Since the latter includes the zones of the English Lower Greensand down to the base of the Sandgate Beds, and also, at the top, the *Schloenbachia rostrata* beds of the Upper Greensand, this "Gault" is closely synonymous with the serviceable "Selbornian" of Jukes-Browne, and with "Albian" as used by certain authors. The second memoir is a morphological study by C. Bärtschi of "Das westschweizerische Mittelland," the lowland stretching from the Lake of Geneva to that of Constance. Here the great extension of the Rhone glacier has left abundant traces. The remarks on drumlins and kames will especially interest British readers.

The meteorological chart of the Indian Ocean for July, issued by the Meteorological Office, contains useful notes on the cyclonic storms of that region. It is pointed out that in this month the south-west monsoon dominates the meteorological conditions over the Bay of Bengal and the Arabian Sea; intelligence received from the Indian Meteorological Department showed that towards the end of May the prevailing weather conditions in those districts were quieter than usual for the time of year. The tracks laid down on the chart show that the storm centres move to the westward or north-westward across the north of the Bay of Bengal. In the Arabian Sea the monsoon at times attains a force of eight or nine of Beaufort's scale, or from thirty to forty-four miles an hour, but such cyclonic disturbances are generally of little importance. Cyclonic storms are said to be practically non-existent in July in the South Indian Ocean; details of their behaviour in that part during the cyclonic season, November to May (Nature, October 31, 1912), are also referred to in the chart now under report.

In the issue of *The Manila Times* for May 20 last, which has been sent to us, is published the report of

Father Jose Algue, head of the Weather Bureau of the Philippine Government, of the typhoon which lasted from May 4 to May 10, and caused great destruction over a large area. The first warning of this typhoon was given by the observatory of the Weather Bureau on May 4, and it was sent to the observatories of Hong Kong, Shanghai, Tokyo, and to the secondary station of the eastern Visayas. Frequently during each of the succeeding days throughout which the typhoon raged Father Algue was able to keep in touch with important observing stations, and to give instructions as to the exhibition of appropriate signals and information as to the progress of events. The telegrams sent to Hong Kong and to the other observatories of the Far East gave an account of the course of the typhoon within the archipelago; thus, for example, the telegram sent at 9.40 a.m. of May 6 read as follows: "The typhoon is at present close to meridian 122° E. and parallel 12° N., moving W.N.W.," while the message sent at 8.40 a.m. of May 7 said: "The typhoon is close to meridian 120° E. and parallel 13° N., moving W.N.W." While the vortex of the typhoon was crossing the islands of Samar and Leyte the area of hurricane winds was approximately fifty miles in diameter. Within this area both the winds and the sea were extraordinarily violent. The rapidity of the fall of the barometer was so great in the China Sea that there was a fall of 20 millimetres in one hour.

DR. L. W. AUSTIN, of the United States Naval Radiotelegraphic Laboratory, contributes, in the June number of the Journal of the Washington Academy of Science, a short article to the discussion of the cause of the difference in strengths of day and night signals. The data accumulated in his department during the last three years render it improbable that the difference is due to a decrease of absorption of the waves in the upper atmosphere after the withdrawal of the sun's rays. With arc oscillations it is repeatedly found that when the night signals are weak at the receiving station with the usual wave-length of 4100 metres, a change of the wave-length to 3950 metres strengthens them and *vice versâ*. This, in the author's opinion, points to an explanation depending on the interference of waves travelling along near the ground, with waves which have been reflected from a surface forty or sixty miles up, at which the conductivity of the atmosphere changes with more or less suddenness. In the daytime this stratification is broken up by convection and by the ionisation produced by the sun's rays.

IN the *Verhandlungen* of the German Physical Society for May 30, Dr. E. Goldstein, of the physical laboratory of the Berlin Astronomical Observatory, gives a preliminary account of a new line spectrum belonging apparently to helium. It appears that Dr. Goldstein first observed the spectrum in 1907, and in the intervening years has obtained many specimens of purified helium from Prof. Dorn, Sir W. Ramsay, Drs. Heuse and Scheel, and others, and has convinced himself that the lines are due to the helium itself or to some other elementary gas, and not to any compound. The new spectrum is characterised by the great number of close lines on each side of the yellow helium line. Prolonged cooling in liquid air has no effect on it, and up to a certain point increase of pressure of the gas increases its intensity with respect to the ordinary series spectrum. Dr. Goldstein regards the new spectrum as bearing the same relation to the series spectrum as the second spectrum of hydrogen bears to the series spectrum of that gas. A photograph of the spectrum with the scale of wavelengths is given, but the author proposes to publish his more accurate measurements in a subsequent paper.

WE have received from the Norton Company, of Worcester, Massachusetts, pamphlets describing articles for laboratory use made with the material "alundum." This substance is stated to be practically pure fused alumina, prepared from bauxite by means of the electric furnace. Its high melting point (2050° C.) renders it of value as a refractory agent in high-temperature work, and the manufacturers claim that this property, together with good thermal conductivity, makes alundum very efficient—for example, as a material for cores and muffles in electric furnaces. Crucibles, tubes, combustion boats, and similar apparatus are also described. For fashioning into articles the alundum is ground to various degrees of fineness and mixed with what are rather vaguely referred to as "materials of a ceramic nature," the mixture being subsequently fired. The finished products are therefore more or less porous. Within limits, the porosity can be varied to allow of the substance being used in making such articles as filtering tubes, filter plates, and thimbles for fat extraction. Sometimes the absorbent nature of the material would be a drawback, but for many purposes alundum products may prove useful in the laboratory.

IN *The Biochemical Bulletin* (vol. ii., No. 6, p. 237) Mr. Vernon Krieble, in a paper on the synthetic action of emulsin, states that emulsin, freshly extracted from sweet almonds, when allowed to act for three and a half hours on amygdalin, gives rise to lævo-mandelonitrile, whereas the emulsin from bitter almonds gives a dextro-mandelonitrile. No experimental details are given in the brief note quoted; these will be published later.

WE have received a copy of a lecture recently delivered before the Institute of Chemistry by Mr. C. A. Hill, on the function and scope of the chemist in a pharmaceutical works. Mr. Hill gives a useful account of the nature of the manufacturing operations involved in the preparation of pharmaceutical chemicals and drugs, and illustrates his descriptions by means of photographs of actual plant; the character of the analytical work in such an establishment is described in general terms, and the possibilities of investigation, either in connection with the improvement of working processes or of a more purely scientific character, are briefly indicated.

PROF. WALDEN has contributed to the June issue of the Bulletin of the St. Petersburg Academy some further data in reference to the relationship between conductivity and fluidity. He had already shown that, in the case of tetraethylammonium iodide, the product $\lambda_{\infty} \times \eta_{\infty}$ = const., the values of λ_{∞} and η_{∞} varying sixteen-fold, whilst the product varied only by 2 per cent. Similar experiments are now described with six additional salts, namely $N(CH_3)_4I$, $N(CH_3)_4NO_3$, $N(CH_3)_4CNS$, $N(C_5H_{11})_4I$, piperidine picrate, and triamylamine picrate, fourteen organic solvents being used altogether in the different experiments. The same remarkable constancy of the product $\lambda_{\infty} \eta_{\infty}$ was noticed in every case, whilst the two picrates gave the same constant when the measurements were extended to aqueous solutions.

A SET of a new series of Contoured County Hand Maps, issued by Messrs. G. W. Bacon and Co., Ltd., at 1*d*. net each, has been received. The maps will be of real service in those schools, fortunately an increasing number, where the teaching of geography is based upon practical exercises worked by the pupils themselves. The maps will make it possible for children to appreciate the importance of the relief of an area in determining its geographical character.

A COMPLETE catalogue of the books in the Central Lending Library at Coventry is being issued in five parts. The first part, which has been received, is concerned with scientific subjects and various arts. The catalogue is divided into an author and title index, a class list, and a subject-index. The librarians may be congratulated upon a careful piece of work which should prove very useful to readers using the library.

PARTICULARS of some of the most efficient forms of optical lanterns and accessory apparatus are stated in an illustrated catalogue just published by Messrs. Reynolds and Branson, Ltd., of Leeds. Prominence is rightly given to the Stroud and Rendell science lanterns, which can be adapted to many purposes, and are equally useful for the projection of lantern-slides, apparatus, or practical experiments in science teaching. The "Rystos" petrological micro-polariscope is an instrument designed by Dr. Dwerryhouse to project upon the screen sections of minerals and rocks as nearly as possible under the conditions in which they are seen under the microscope. The notes given in the catalogue on the arrangement of lantern and accessories for various demonstrations illustrate the flexibility of lantern apparatus for purposes of instruction.

THE Year Book for 1912 of the Carnegie Endowment for International Peace has now been issued. In a letter dated December 14, 1910, addressed to the trustees of the endowment, Mr. Carnegie said:—"I have transferred to you as trustees of the Carnegie Peace Fund, 2,000,000*l*. of five per cent. first mortgage bonds, the revenue of which is to be administered by you to hasten the abolition of international war, the foulest blot upon our civilisation. Although we no longer eat our fellow-men nor torture prisoners, nor sack cities, killing their inhabitants, we still kill each other in war like barbarians. Only wild beasts are excusable for doing that in this the twentieth century in the Christian era, for the crime of war is inherent, since it decides not in favour of the right, but always of the strong." The year-book details the steps which up to the present the trustees have taken to secure the objects aimed at by the fund. The numerous reports—of the executive committee, the secretary, and of the directors of the various divisions into which the work of the trustees is divided—all show that strenuous and successful efforts are being made in many parts of the world to educate peoples in the desirability of abolishing war as a means of settling disputes.

OUR ASTRONOMICAL COLUMN.

A SOLAR OBSERVATORY FOR NEW ZEALAND.—For many years it has been felt that the European and American Solar Physics Observatories should be supplemented by similar observatories in that great stretch of longitude which at present is not represented. The establishment of Kodaikanal was a tremendous advance in the right direction, and a further successful step was taken by the founding of the new observatory in Australia; the latter, we hope, will soon be in active operation. By the generosity of Mr. Thomas Cawthron, of Nelson, New Zealand, this chain of stations will be carried still further east by about 25° of longitude, for he has offered to build, equip, and endow a solar observatory in the vicinity of Nelson. The climate of Nelson seems admirably suited for such a station. The choice of the actual site is, according to a communication from Miss Proctor, in the hands of Sir Robert Ball, who has been requested to send a representative to select that which is most advantageous, and also to give estimates regarding the equipment. Let us hope that this, the "Cawthron Solar Observatory," will soon be in active operation also, thus completing the girdling of the earth from the solar physics point of view.

A CURIOUS ASPECT OF JUPITER'S THIRD SATELLITE.—J. Guillaume communicates to the *Comptes rendus* for June 9 an interesting observation relative to the appearance of Ganymede, Jupiter's third satellite, near the end of its transit across the planet. Instead of the regular circular disc which it usually displayed, he noticed on May 24 last that it had a gibbous form, reminding him, as he says, of Mars at the epoch of quadratures, and, furthermore, that it showed a very white north polar spot with a grey zone smaller in the eastern part than in the western part. These details were more apparent when the satellite was projected on the disc than when off it. M. Guillaume remarks that he has seen this appearance several times in 1890 and 1893 with a reflector of 0·216 metre aperture, but never in such a conspicuous manner as on May 24, when he was using the equatorial coudé (aperture 0·320 metre) at the Lyons Observatory.

THE STAR CLUSTERS IN PERSEUS, N.G.C. 869 AND 884.—In vol. ii., No. 2, of the *Astronomische Abhandlungen* of the Hamburg Observatory in Bergedorf, Dr. B. Messow publishes the discussion with the results of the mean positions and brightness of 649 stars in the two clusters in Perseus N.G.C. 869 and 884, after his measures of two photographic plates. The plates were secured on October 3, 1899, by Herren Eberhard and Ludendorff, with the small photographic refractor (34 cm. aperture, 3·4 m. focal length) of the Astrophysical Observatory at Potsdam, and the exposures lasted five minutes each under good observing conditions.

Towards the end of the memoir he makes a comparison with ninety-six stars of the same cluster, taken by Rutherford during the years 1870–74 and measured by Miss Young, and he finds that they agree within very small limits, with the exception of one star. Omitting this, and two others which were measured only on one of his two plates, the differences Young minus Messow were as follows:—

$$D_{\alpha} = 0{\cdot}000s. \qquad D = +0{\cdot}01'$$

A further investigation of the differences between Young and Messow as regards proper motion leads the latter to state that the two star clusters have not altered their position in space. The memoir concludes with a catalogue of the positions of the 649 stars for 1899–1900, together with their estimated and measured magnitudes.

Oxford University Observatory.—From the thirty-eighth annual report of the Savilian professor of astronomy we learn that the Cambridge ledgers containing the corrections to the Cambridge meridian observations from all the separate plates taken at Oxford have now been completely revised and discussed for magnitude equation. It has been found that the observations of faint stars are affected by considerable and rapidly changing errors, such as Prof. Arthur Searle found at Harvard. To enable this work to be accomplished, the work on differential star places had to be temporarily put aside. We are further informed that two zones (+64° and +63°) of the Vatican plates have been completely reduced with the exception of one doubtful plate in zone +63°. This plate has since been repeated at Rome.

THE THIRD INTERNATIONAL ROAD CONGRESS.

The Permanent International Association of Road Congresses, which held its first meeting in Paris five years ago, completed its third congress in London on Saturday last. The attendance of home and foreign members and visitors was far greater than at either of the two previous meetings, and there is no doubt that both in the quantity and quality of the matters discussed, and the general interest taken in the road inspections and in the road-making apparatus shown at the exhibition, this congress showed a marked advance on the two previous ones.

Too much was attempted. Papers on nine important questions had been invited, and the response was such that more than 120 papers replying to the questions alone had been received, to be translated into the three official languages—English, French, and German—and summarised for discussion by carefully selected reporters. The discussions were on these summarised reports, and as the resolutions voted on after their discussion reach 4500 words in English, 5500 in French, and about the same in the German readings, it will be seen that much has been attempted.

The questions on which papers were invited were the following:—(1) The planning of new streets and roads; (2) the best types of surfacing to be adopted on bridges; (3) the great question of bituminous construction of macadamised roads; (4) wood paving; (5) the best methods of lighting streets and highways; (6) the causes of deterioration of road surfaces noted since 1908; (7) the regulation of fast and slow traffic; (8) the functions of road authorities; (9) finance and the incidence of taxation necessary for the upkeep of the roads.

In addition, communications on many important subjects were invited, but on these, although many of them contained much valuable data, there was no time for discussion.

The resolutions discussed and voted on are really condensed summaries of the average opinions contained in the papers, and therefore have a certain value as indicating the general trend of well-informed opinion on road matters in the year 1912, for on account of the time necessarily occupied in the preparation, printing, translation, and summarising most of the conclusions arrived at last week were based on papers written nearly a year ago.

It was, of course, inevitable that a great mass of the contributions came from countries where road construction and road problems are not in a very advanced state, so that the real interest to the more scientific members present lay in the opportunities that these meetings give for personal discussion of the problems which are now presenting themselves in this most interesting branch of engineering.

All who are studying the modern road development which is called for by the steady demand for door to door transport of passengers, as well as goods, know that the question of the time is how to produce road surfaces which are efficient from the point of view of reducing so far as possible the running cost of the vehicles which use them, at the lowest cost for road construction and annual maintenance.

It is almost unnecessary to repeat what has been so often urged, that road engineering demands as intimate a study of the action of the wheel rolling on the road surface as has been devoted to the same question on railways, with such marked economy in the cost of railway transportation. On account of the widely varying type of the vehicles running on the roads and of the great variety of their means of propulsion, and of the fact that for many years to come horse-drawn as well as mechanically-propelled vehicles will use the same road surface, the problems of construction and maintenance are certainly more complicated than those of the railway.

At the informal meetings of the more scientific of the engineers who visited London last week many interesting views were interchanged which cannot fail to further the science of road engineering, as has been found to be the case at the international meetings of the Iron and Steel Institute, where such informal discussions have always been the real feature of the meetings.

On account of the abundant supply of bituminous binding material provided by the tars and pitches from our gasworks, England has made an exceedingly good start in the science of binding road surfaces with tarry matter. On the other hand, America made her first road developments by using the bitumens which are either obtained from natural deposits or as the residuals from the distillation of some of the earth oils. Quite recently the demand for the various forms of petroleum for power and heating purposes has increased the production of the bituminous residuals, and it is likely that the low cost of freight will enable America to supply these residuals to English road engineers as a formidable rival to the tars and pitches which have been in use up to the present.

One of the most interesting features to the scientific members of the congress has been the inspection of the trial lengths of roadways laid down by our Road Board to enable various road materials, such as the roadstones, the tars, and bituminous binders, to be tested under fixed and regular conditions of heavy traffic at Sidcup, Wandsworth, Fulham, and on other roads and streets in and near London. In addition, the latest scientific development of road apparatus was shown to the members of the congress at the National Physical Laboratory at Bushy, where the "road machine" was shown in action; this machine having been designed to reduce the time necessary to test road materials from many months down to a corresponding number of hours. The machine was only completed a few weeks ago, but the few tests already made on improved road surfaces have already directed attention to several interesting phenomena which had long been suspected by road engineers, but were incapable or difficult of proof on the ordinary roadway on account of the great variations in weather, traffic, and other matters which render accurate comparative tests difficult, if not impossible.

OPENING OF THE NEW WING AT ROTHAMSTED.

ON Friday, June 27, the new wing of the Rothamsted laboratories was opened by the Right Hon. Walter Runciman, President of the Board of Agriculture, in presence of a large and distinguished company, which included Earl Grey, Earl Denbigh, Earl Rosse, Lord Lucas, Prof. H. E. Armstrong, Mr. G. W. Lamplugh, Dr. W. N. Shaw, Sir William Tilden, Sir David Prain, Dr. G. J. Fowler, Dr. J. A. Voelcker, and others.

The new wing (on the right) adjoining the old one-storey building of the Rothamsted Experiment Station.

In his opening remarks the chairman (Sir John Thorold) stated that the wing now ready for opening was the third great advance during the last few years at Rothamsted. The first was made in 1906, when Mr. J. F. Mason gave the James Mason Bacteriological Laboratory, and provided funds for its maintenance; the second was made in 1907, when the Goldsmiths' Company gave a grant of 10,000*l.* towards soil investigations; and the third became possible when the Government instituted the Development Fund, out of which part of the cost of new buildings could be met.

In declaring the buildings open, Mr. Runciman sketched out the history of the Rothamsted Experiment Station from its beginning in 1843 to the present time. The experiments grew out of some pot trials made by Lawes as a young man in the late 'thirties. The first result was the discovery of superphosphate, which alone had proved of almost incalculable benefit to the world, markedly increasing the yields of some of the British and Continental crops, and rendering possible the economic growth of wheat in Australia. Feeding experiments on animals came later, and proved of fundamental importance both to farmers and physiologists. During the fifty-seven years of their partnership, Lawes and Gilbert had investigated most of the important problems connected with British agriculture, and laid the whole community under a great debt of obligation to them. The work thus begun had expanded considerably under Mr. Hall's directorship (1902–12), and the growth was such that the new wing was already full, and the director, Dr. Russell, was preparing plans for new buildings to be erected in commemoration of the centenary of the birth of Sir John Lawes (1814) and Sir Henry Gilbert (1817). Mr. Runciman expressed the hope that the centenary fund would be well and widely supported.

Mr. J. F. Mason, M.P., who followed, recognised that farmers had evolved an admirable system of agriculture, but pointed out that every industry benefited by scientific aid. He instanced the steel industry as one in which science had done great things. Already science had done much for agriculture, and there is every reason to suppose that it will do more.

Earl Denbigh and Sir Hildred Carlile both paid high tributes to the work that is being done at Rothamsted in relation to British agriculture, while Earl Grey emphasised the enormous part that has been played by science in the development of Canadian agriculture.

The buildings were then inspected. They include a large soil laboratory and directors' room on the ground floor, a botanical laboratory, library, and chemical laboratory on the first floor, and a glass-house for water cultures on the roof. Special rooms are provided in the basement for polarimeter work and for soil incubations. The laboratory is served throughout with electric current, which is generated in an adjoining dynamo and battery house. The total cost of the building and fittings is about 3400*l.*, and the expenditure on the new farm (which has been taken over to supplement and extend the old experimental fields) is about 3200*l.* Towards this the Board of Agriculture has made a grant of 3100*l*. out of the Development Fund, and has also promised an annual maintenance grant of 2500*l*. from the same source. These grants are made on the "pound for pound" principle, *i.e.* they are given subject to an equal amount being raised from other sources. The Society for the Extension of the Rothamsted Experiments was founded for the purpose of collecting subscriptions, and is now making a further appeal. Subscriptions and donations should be sent to the secretary, the Rothamsted Experiment Station, Harpenden.

It is hoped to raise 6000*l*. as the centenary fund, and thus to qualify for a further grant of 6000*l*., making a total of 12,000*l*., a sum which it is estimated will give buildings and appliances adequate for some years to come.

THE GLASGOW MEETING OF THE INSTITUTION OF NAVAL ARCHITECTS.

THE Institution of Naval Architects held a successful and largely attended summer meeting in Glasgow on June 23–27. An interesting series of visits to works and excursions had been arranged, that to Messrs. Beardmore's shipyard, and the excursion to Arran with which it was combined, proving particularly enjoyable. While most of the papers dealt with purely technical matters, one or two were of more general interest.

In a paper on safety of life at sea, Mr. Hillhouse summed up the present state of affairs from the point of view of the naval architect. Apart from careful navigation the three factors on which we have to rely are wireless telegraphy, subdivision of hulls, and a sufficiency of boats. Of these, the adequate subdivision of hulls presents very serious constructional difficulties, and offers few advantages in the case of fire, while it is almost impossible to provide sufficient small boats and to guarantee that they shall all be usable in the moment of emergency. The one thing on which we can insist is careful navigation, although this may involve some reduction in speed.

Dr. S. J. P. Thearle directed attention to a number of cases in which cracks have developed in the shell plating of a steel vessel at points removed from rivet-holes and from the edges of the plate. These have been found to occur only in the vicinity of a frame unsupported by any beam, and are evidently due to "fatigue" following alternate stressing of the plate by "panting."

In a paper on the effect of form and size on the resistance of ships, Mr. J. S. Baker dealt with the effect of an increase in the length of the parallel portion of a vessel and of fullness of form. The problem was first attacked from a theoretical point of view on the assumption of stream-line flow; the distribution of pressure around the hull was computed; and a law deduced for the speed at which transverse wave-making occurs. These results were compared with those obtained from model experiments, and from these the author deduces an expression for the most economic length of parallel body to be associated with a given entrance and run.

Prof. A. H. Gibson and Mr. Hannay Thompson read a paper dealing with the theory of "suction," or interaction between passing vessels, and with an extensive series of experiments carried out to investigate this important question. The vessels used were respectively 90 ft. and 30 ft. in length, displacing respectively 96 and 2·6 tons. The experiments were divided into two sets, one dealing with the behaviour of the vessels when moving at different distances apart and at different speeds with helms lashed amidships, and the other dealing with the helm angles necessary to maintain a straight course and with the forces and moments operative to produce deflection of the course under similar conditions. The experiments were carried out in deep and open water, and the authors conclude that even in these circumstances interaction is a very real danger to navigation under certain conditions. The danger would appear to be greatest when the larger vessel is passing the smaller in fairly close proximity at a speed not greatly in excess of that of the smaller. In such circumstances, particularly if the larger be at the time accelerating with a view of drawing out of range of the smaller, the latter may be drawn into collision, except in so far as prevented by the helm, from distances as great as three or four lengths of this vessel. With the vessels within one length of each other the helm required to keep the smaller on its original course varied with its longitudinal position relative to the larger, and with their relative speeds. When all circumstances favoured interaction a helm angle of as much as 20° was necessary to prevent collision. Generally speaking, since the helm effect increases somewhat more rapidly than that of suction, a vessel is more easily controlled against these forces at high than at low speeds.

An interesting paper by Mr. A. Cannon records the results of experiments with an apparatus designed by Sir H. Biles on principles laid down by Colonel Russo, R.I.N., to investigate the effect of internal loose water upon the rolling of a ship amongst a regular series of waves, while a paper by Mr. Lloyd Woodward, dealing with the theory of the same subject, forms a useful supplement to this. The experiments point to the conclusion that, generally speaking, the addition of free water decreases the angle of roll, and always does so if its quantity is limited. If, however, the quantity is fairly large, and particularly in short and high waves, the effect is to increase the angle, and under a certain combination of wave-lengths and height the angle may become dangerous. Further, these large angles are attained in a very few rolls, and it is quite possible for them to be attained in an actual ship, although the resistance to roll may be very great.

In a paper which was taken as read, Prof. L. Gümbel dealt with the cavitation of screw propellers, concluding that the tendency to cavitation not only increases with a diminution in the depth of immersion and with the amount of dissolved air in the water, but also depends very largely on the pitch of the propeller, on the angle formed by the feather edge in the cross section of the blade, and on the amount of slip. As regards the latter point, the limit of slip which may take place without cavitation is reduced as the speed of the vessel increases. On the other hand, the occurrence of cavitation is not dependent on the surface pressure over the blade area. A small angle at the emersion edge is more easily obtained with a broad-bladed propeller than in one with narrower blades. In this fact lay, in the author's opinion, the secret of the success that had been obtained with turbine screws with broad blades. Since, however, broad blades involve increased friction, an attempt should be made to so form the cross section as to get a narrow blade with the minimum possible angle of emersion.

Other papers descriptive of the results of trials on modern vessels propelled respectively by geared turbines and by Diesel engines enable an interesting comparison to be gained between the performance of these types of motor. In the turbine installation of 2400 b.h.p. the steam consumption was only 12·55 lb. per shaft h.p., the ratio of effective h.p. to shaft h.p. attaining a maximum value of about 58 per cent. at about 480 revolutions per minute. With the Diesel engines, of 1000 h.p., the remarkably low consumption of 0·37 lb. of oil per shaft h.p. was obtained.

In the concluding paper of the meeting Messrs. Reid and Mavor made out an excellent case for electrical propulsion in conjunction with Diesel engines in the type of large canal barge or freighter used to such an extent on the great inland waterways of North America. The efficiency of such a vessel depends very largely on the ease and rapidity with which it can be manœuvred, reversed, accelerated, and backed, during its frequent passages through the locks on these waterways, and this puts the direct-coupled Diesel engine, under present conditions, out of court.

THE NATIONAL PHYSICAL LABORATORY

Opening of New Building.

THE new building at the National Physical Laboratory, Teddington, was opened by the Right Hon. A. J. Balfour on the day of the annual visitation, Thursday, June 26. The opening ceremony was held in the structure designed for the new wind-channel for aëronautical work. A large and distinguished company foregathered, including Sir Archibald Geikie, who presided, Colonel Seely (Secretary of State for War), Lord Rayleigh, Lord Allerton, Lord Welby, Viscount Esher, Lord Montagu of Beaulieu, Sir Oliver Lodge, Sir Wm. Crookes, Sir Wm. Ramsay, Sir John Brunner, Sir Albert Spicer, and Dr. R. T. Glazebrook (director of the laboratory).

The chairman, in his opening remarks, referred to the amazing growth of the laboratory and the place it had taken as one of the most important national institutions in this country.

Dr. Glazebrook dwelt on the noble liberality of the friends who had so splendidly supported the laboratory in the past, and Lord Rayleigh emphasised the fact that funds were still needed for equipment purposes. Lord Rayleigh went on to express the hope that in the future larger funds would be available to enable greater attention to be paid to research in pure science, as well as to work calculated to further the immediate ends of industry.

Mr. Balfour gave an interesting and thoughtful address dealing largely with the national advantages of the study of pure science. In the course of his address he remarked :—

Measuring is the very life-blood of physical science. It lies at the root of almost all great discoveries and their application to practice. It is impossible not to acknowledge the benefit which mankind has received by the command which science has given us; and measurements and testing are absolutely essential to science. The great features of a national laboratory are its impartiality, its ability to bring an adequate staff and adequate machinery to bear on problems, and the standard of perfection which it sets for instruments and which serves as an ideal for manufacturers to work to. The advantages to industry are beyond all doubt and beyond all question.

But the successes of the future of industry depend on the abstract of purely scientific investigations of the present, and it is to the labours of the man of science working for purely scientific ends, and without any thought of the application of his doctrines to the practical needs of mankind, that mankind will be most indebted as time goes on. The general public does not realise that it is to the results of pure science that we have owed in the past, and shall owe more and more in the future, all great advances in industrial knowledge and practice. Still less does it realise that the man of science who is working continuously towards that end is only half a man of science, and is not likely to do his scientific work nearly so well as if he were simply and solely occupied in advancing that branch of knowledge with which he is connected.

When these important truths have sunk into the public mind, we may see, as a reflection of that new conviction, a different attitude adopted by those who have to settle what expenditure should be presented to Parliament for its sanction, and the attitude which Parliament itself may take in the face of such suggestions. The growth of this great institution during its very few years' existence justifies us in looking forward to a great and glorious future for it. The thanks of the public are due to the brilliant and hard-working staff of the laboratory who, under no small difficulties, are the real authors of the triumph which we are met to celebrate.

After the opening ceremony, an inspection was made of the new building, and visitors wandered at will through the various departments of the laboratory, in which a series of interesting demonstrations had been arranged.

The new building marks the completion of a scheme for the erection of laboratories for metallurgy and optics, and of a building for administration purposes. The late Sir Julius Wernher made himself responsible for the funds for the metallurgical laboratories, and for the rest, the Treasury, the 1851 Commissioners, and some of the City Companies have made generous contributions.

One of the main objects for which the new laboratories have been erected was to enable the testing work, until recently carried out at Kew Observatory, to be transferred to Teddington. Kew Observatory is in future to devote itself purely to meteorological objects—it is now, in fact, the central observatory of the Meteorological Office—while the testing of instruments of all kinds will be undertaken exclusively at Teddington.

The new building provides accommodation for the administration and optics departments, together with workshop and packing rooms. The optics wing is designed to accommodate the optical testing work hitherto carried out at Kew and in a suite of rooms at Bushy House. The latter rooms are now occupied by the thermometer-testing observers from Kew, while the remainder of the Kew test-work has been housed in the metrology department.

The new building, of which we show an illustration, is a three-storey structure built of purple Surrey bricks with red brick facings. The architecture is of the Queen Anne period, and the structure bears a general resemblance in style to Bushy House, alongside which it stands, and which, it will be recalled, formerly housed the whole of the work of the laboratory. The new building impresses one as being generously lighted and very substantially built, and reflects great credit on the architect, Mr. W. D. Caröe, and on the clerk of the works, Mr. R. Allen Jane.

Great care has been bestowed on the fireproof qualities of the building; the floors and stairs are of ferro-concrete throughout, and generous provision has been made for fire hydrants. This feature is, of course, doubly important in a building one of the functions of which is to house important records.

The ventilation is controlled by a large fan on the roof, communicating by ducts to extractors in the ceilings of the different rooms. Fresh air is admitted through louvres behind steam-heated radiators provided with suitable baffle plates.

The corridors throughout are covered with Doloment patent flooring; the woodwork is chiefly oak, the effect of which is altogether admirable.

To take the central block of the new building first. Opening on to a large central hall on the ground floor are the accountant's offices and strong-room, reception-rooms for visitors, and a telephone exchange room; on the first floor are the director's room and the secretarial offices; on the second floor, *inter alia*, the "White Library," a publications room, and a lecture theatre. The library is being furnished by the Drapers' Company in memory of the late Sir William White, to whose good-will and energy the laboratory owes a great deal. A brass memorial tablet records that "The Worshipful Company of Drapers of the City of London, mindful of the last wishes of Sir William Henry White, K.C.B., F.R.S., gave to the Laboratory the bookshelves in this library." The fittings are being carried out in old oak, and the library, with its panelled walls, recesses, and gallery, brings to mind some of the college libraries at the older universities.

It is anticipated that the new lecture-room will afford facilities for meetings of scientific societies, for many of which an annual visit to the laboratory has become a recognised function. It is hoped also that opportunity will be afforded to the members of the staff of hearing distinguished visitors at a fortnightly or monthly colloquium.

New building of the National Physical Laboratory.

The central block is isolated from the north and south wings by fireproof doors.

On the ground floor of the optics division are two large semicircular arch-shaped tables made of cast-iron. One of these is vertical and the other horizontal. They are used to test the accuracy of graduation of theodolite circles and sextant arcs. One face of each table is machined, and to it are bolted at definite angles collimators pointing to the centre of the semicircle. The tables rest on isolated masses of concrete weighing some 20 tons; and to avoid troubles due to seasonal and extraneous temperature changes, the tables and supports are hollow throughout, and are kept at uniform temperature by circulating water through them. In the same room is a tilting table with standard wedges for testing clinometers. The photometer and spectacle-lens benches are mounted in an adjoining room, along one end of which is a movable partition which can be removed when extra long-focus process lenses are being tested. A rapid and convenient system of light-tight blinds is a noteworthy feature of the fittings. The testing of microscopes is conducted in an adjoining room.

On the first floor, a group of rooms is allotted for testing terrestrial telescopes. One of these can be completely darkened for the purpose of examining the parallelism of the axes of binoculars, or the illumination of cross wires. Test objects and scales of various forms, and at distances up to 400 yards, have been erected.

A long ferro-concrete balcony (which, by the way, was cast in one mould complete) extends along the outside of the first floor. This will enable open-air tests to be made on instruments.

On the second floor, the equipment for examining photographic lenses is grouped in adjoining rooms. Here are, for example, the Hunter apparatus for obtaining a numerical estimate of definition; the Beck bench for measuring focal length, astigmatism, curvature of field, &c. The testing of photographic shutters is carried out here, by the use of vibration galvanometers tuned to resonance with electrically-driven tuning-forks or vibrating bars.

Next is the room devoted to spectroscopy, and in particular to the examination of refractometers and spectrophotometers. A feature of the room is a large roller shutter by means of which the room can be readily divided into two. The shutter is provided with suitable apertures, to fit the various instruments under test, and will be brought into use when it is important that the eyes of the observer should not be exposed to bright lights during the test.

The remainder of the rooms are given up to the general photographic work of the laboratory. There is an unusually well-designed and ventilated suite of dark-rooms with light-trapped doors and the like. Other rooms are specially designed and illuminated for photographing apparatus and diagrams.

The roof of the building is flat and asphalte-covered, and on it at one end is arranged an observatory. This is to be fitted with a telescope with an equatorial mounting, and a dome. The telescope is designed so that object-glasses sent for test can be mounted as in actual use.

The north wing contains the packing-rooms and the associated clerical offices, together with store-rooms and wood and metal workshops. Arrangements have been made here for the engraving of instruments with the familiar NPL mark—outward and visible sign that an instrument has passed its tests. Copious provision was necessary for dealing with the packing and unpacking of cases containing instruments, the handling of which under the old arrangements was fast becoming a problem owing to the volume of stuff which had to be dealt with. There is a large Waygood lift, to which leads a sunk track for wide rubber-wheeled trolleys. Thus these latter can be run on the lift, and so to the various corridors and rooms. There is a second lift to the workshops. In this block, a common-room for the laboratory boys has been provided.

The foregoing description will perhaps give an idea of the admirable manner in which the new building has been designed for its work.

DEATH BY ELECTRIC CURRENTS AND BY LIGHTNING.[1]

Death by Electric Currents.

I BELIEVE that no loss of human life from industrial currents of electricity occurred before 1879, though currents strong enough to have caused death were employed in lighting the operatic stage in Paris (at the first performance of Meyerbeer's "Le Prophète") so long ago as 1849, and in lighthouses on and off the coast of England in 1857. In 1879 a stage carpenter was killed at Lyons by the alternating current of a Siemens dynamo that was giving a voltage of about 250 volts at the time. The man became insensible at once, and died in twenty minutes; artificial respiration was not applied. The first death in this country took place at a theatre in Aston, outside Birmingham, in 1880, where a bandsman short-circuited a powerful electric battery, became insensible, and died in forty minutes. Since that date the annual number of deaths from electric shock has steadily increased, particularly during this century, in which the industrial employment of electricity has extended so widely, and is now quite large. In the ten years 1901–10 the Registrar-General's returns show a total of 183 such deaths in England and Wales, the population having risen from 32½ to 36 million during that period. In the three years 1901 to 1903 there were twenty-five deaths; in 1908, twenty-five; in 1909, twenty-nine; in 1910, twenty-six. Only two of these 183 victims were females, because women are so much less exposed to contact with dangerous electric currents than are men. Many deaths by electricity occur annually on the Continent, though I can only bring forward a few scattered figures to prove it. In Germany, thirty-three were killed in 1908; fifty-two in 1909; forty-six in 1911. In Austria eleven were killed by electricity in 1907; ten in 1910; ten in 1911. In Switzerland, twenty-one were killed in 1905; nineteen in 1906. I think it probable that about 200 persons are killed by electricity annually over the whole of Europe. As regards the United States of America, where electricity is so very extensively employed, I have not been able to find any statistical records. So long ago as 1888 Brown estimated that during the past five years some 200 people had been killed by handling live electric wires. One must remember that in America life is held very cheap, and that safeguards and protective legislation tend to be regarded as undue restrictions upon industry and commerce. I imagine that not fewer than 200 persons are accidentally killed by electric currents every year in America. As a rule, only a single person is killed by electricity in any single accident; but in an accident occurring in 1909 at Olginate, a village in Lombardy, ten people were killed outright by a three-phase current at 3000 volts, one was saved by artificial respiration, and about a dozen more were severely injured (Hoest).

The interest of men of science, of physicians and pathologists, in such deaths was first shown in France. In 1882 the celebrated French medico-legal expert and pathologist, Brouardel, made a careful *post-mortem* examination of a man killed in Paris at the Tuileries by a 250-volt alternating current, and he decided that death was fulminating, due to the electric discharge, and directly caused by arrest of the heart. Bourrot at the same time examined a second and similar case *post mortem* and came to the conclusion that death was due to violent excitation of the vagus nerve and consequent arrest of the heart, with the result that the heart could not resume its functions, and death by asphyxia followed. In 1885 a man killed instantaneously by electric shock at the Health Exhibition in London was examined forty hours after death by Sheild and Delépine. *Rigor mortis* was marked; extreme fluidity of the blood was observed, even the right heart being free from clots. The authors came to the conclusion that "No doubt the vital spots at the base of the brain are in such cases markedly implicated."

During the last twenty years a great many *post-mortem* examinations have been made in cases of sudden death by electric shock. Burns of greater or less superficial extent are generally seen at the points where the electric current has entered and left the body. In the second place, abnormal fluidity of the blood has often been found *post mortem*; in this, those cases of sudden death by electric shock resemble cases of sudden death by asphyxia. In the third place, no pathological changes are regularly found in the heart muscle, although there are good reasons for believing that in most instances death is directly due to paralysis of the heart. In the fourth place, the central nervous system often shows neither macroscopical nor microscopical changes of importance, except in the cases where relatively large quantities of electricity have passed through the body for long periods of time. In a word, the *post-mortem* evidence as to the cause of death by electric currents in industrial accidents is generally negative, but may suggest asphyxia in some cases, in others organic vascular and nervous lesions in the brain and cord.

It is upon the evidence obtained by the experimental electrocution of animals that most of our knowledge as to the modes of death by electric shock rests. No electrical apparatus capable of producing currents strong enough to kill animals was invented before about the middle of the eighteenth century. At that time electricity suddenly developed into a popular and spectacular science in France and Germany, just as in the middle of the nineteenth century table-turning, spiritualism, and clairvoyance were popularly taken up all over England and America with the greatest energy. In neither case was much real scientific progress made by this arousal of popular interest; birds, beetles, and other living creatures were electrocuted by frictional electricity by Gordon (1745), Gralath (1746), Nollet (1749), and many others (Benjamin). It was noted that the birds exhibited ecchymoses where the electric sparks struck them, much like the ecchymoses seen on persons killed by lightning (Nollet). Priestley in 1767 killed kittens and dogs with the discharges of condensers, and tried without success to resuscitate a kitten by artificial respiration, distending the lungs by blowing with a quill into the trachea. Abildgaard (1775), using condensers and Leyden jars, tried without success to electrocute a three-months-old foal; he succeeded in killing cocks and hens by electric discharges sent through the head, and made the important observation that fowls treated in this way and to all appearances dead could be brought back to life by electric shocks sent through the body from breast to back, but remained dead if not treated in this manner. To mention only a few out of many of those who have since made similar investigations:—

In 1885 Mann made some very interesting experiments on the effects of electricity on the action of the human heart. He applied the electrodes to the præcordia and back, and found that a slowly alternating current of from 15 to 30 milliamperes did not prejudice the heart's action.

In 1885, and further in 1887, d'Arsonval made some interesting remarks on deaths caused by industrial electric currents, advancing the views as to their mode of production that he has continued to hold faithfully

[1] From the Goulstonian lectures for 1913, delivered before the Royal College of Physicians of London by Dr. A. J. Jex-Blake.

ever since. These deaths, he said, were brought about in one of two ways:—

(1) By direct action, the mechanical effect or disruptive action of the electric current on the tissues; or

(2) By indirect or reflex action on the nervous centres.

In the first case death is final; in the second it is often apparent only, so that the victim may recover if treated by artificial respiration immediately after receiving the shock. Most of the victims of industrial electric accidents had died of asphyxia, he believed. The alternative view that these deaths were due to cardiac failure was first emphasised in 1890 by Tatum, and his is the view very generally held at the present time. It was put on a more scientific basis in 1898 by Prevost, who showed that the cardiac failure was the result of fibrillation or fibrillary tremulation of the muscle of the heart, the German *Herzdelirium*, investigated in 1850 by Hoffa and Ludwig. The extremely well-designed and well-executed experiments of Prevost and Battelli (1899) proved the great importance of cardiac fibrillation in causing the death of animals of various kinds when exposed to the passage of electric currents through different parts of their bodies. They also illustrated the various effects of electric currents of different varieties—alternating, continuous, sudden discharges from condensers and induction coils—on these animals, and proved that when apparently killed by a current at a low voltage, animals might be brought to life again by the shock of the much stronger currents forced through their bodies by the application of high voltages. These authors also demonstrated that while an alternating current with a frequency of 150 alternations a second might be fatal to dogs at an E.M.F. of only 15 to 25 volts, when the alternations were increased to 1720 a second, no fewer than 400 volts were required to produce death. Using high-frequency currents with from 400,000 to 1,000,000 alternations a second, d'Arsonval (1893) found he could stand the passage of as much as 3 amperes through his body, a current twenty or thirty times as great as that required to kill a human being at the ordinary rates of alternation employed industrially. The experiments of Cunningham (1899), d'Arsonval (1910), Weiss and Zacon (1911), are also worth recording, and have added considerably to our knowledge of death by electric currents. Weiss and Zacon found that chloral anæsthesia gave dogs no protection against electric shocks. With alternating currents given for a few seconds, death would occur when about 70 to 100 milliamperes traversed the thorax with the heart *en route*; with continuous currents, death was not caused unless the current was as large as 300 milliamperes, roughly speaking. If, however, smaller electric currents were administered for long periods, it was found possible to produce death by tetanus and asphyxia; thus currents of 35 to 45 milliamperes were too small to produce cardiac fibrillation, but after about ten minutes' application caused death by continued inability to breathe, and slow asphyxiation. It may be noted that Prevost and Battelli found that dogs were not killed by alternating currents as great as 4 amperes at 1200 volts, passed through the body from one hind leg to the other; the reason being that with this arrangement of the electrodes the rate of flow of electricity through the muscle of the heart was not large enough to cause it to fibrillate.

One may conclude that living animals of different species are killed by electricity with very different degrees of facility. For example, many experimenters have endeavour to electrocute frogs, but all, I believe, without success, whatever the current used and however it may have been applied. The frog survives electric shocks and the prolonged passage of electric currents at all sorts of voltages—10, 100, 1000 volts and more—and shocks from induction coils and charged Leyden jars. The only inconveniences it suffers appear to be transient pareses or paralyses, and, in the case of strong currents passed for many seconds or minutes, the formation of burns. The frog is thus immune because its heart always begins to beat again regularly and normally after the passage of the electric current, and because its respiration does the same; and also, as Priestley pointed out in 1767, because "its constitution enables it to subsist a long time without breathing." At the other extreme of the scale comes the dog, which can be killed with certainty by an alternating current of perhaps 15 volts or 60 milliamperes, if it is applied so as to pass largely through the heart muscle for a couple of seconds only.

As regards the death of human beings, it may be brought about by electric currents in several different ways.

(*a*) There is no doubt that it might be due to prolonged tetanus of the muscles, which could prevent the performance of respiratory movements, and so lead to death by asphyxia after some minutes. But I am not able to find that it ever has come about in this way as a matter of fact, the victim always being able either to break the contact and interrupt the passage of the current for himself, or to call for help and get the contact broken by somebody else before asphyxia has occurred in this way.

(*b*) In man primary heart failure is undoubtedly the commonest mode of death by electric currents. The experiments on animals already detailed show that such deaths are due to fibrillation of the ventricles of the heart. The fibrillation has been seen occurring in the hearts of two criminals electrocuted in America and examined immediately after death (Schumacher); a few minutes later the left ventricle was firmly contracted and empty, while the right ventricle and the auricles were relaxed in diastole and full of blood. It is probable that in the adult man, as in the dog, horse, and ape, fibrillation of the heart, once it is established, is irremediable, practically speaking.

(*c*) and (*d*) Death by failure of the respiration while the heart continues to beat, brought about by nervous inhibition, or by failure of both heart and respiration together, is probably not so common in man. There is a great want of evidence on this point; naturally enough, as the people who are present at deaths by electric shock are generally workmen who do not busy themselves with observations of the pulse and the respiration of the victim. A good many cases have been recorded in which death did not occur until ten, twenty, or forty minutes after the shock had been received, and was then apparently due to failure of the respiration to re-establish itself. The experiments upon animals would lead one to believe that such deaths are really due to failure of the respiratory centre in the central nervous system. The *post-mortem* evidence in such cases should suggest death by asphyxia, and such evidence has sometimes been found after death by electric shock.

(*e*) Brief reference may be made to the fact that a good many cases have been recorded in which the victim of an electric accident has died after a few days or weeks from complications (shock, gangrene, suppuration, exhaustion following extensive amputations) arising out of the injuries caused by the electric current.

With alternating currents, death has occurred from shocks at voltages as low as 65 volts, and a good many instances of death at such pressures as 100 to 120 volts have been recorded. It is only in very exceptional circumstances that these low voltages can cause death; unless the patient's skin is wet and he makes a good contact, not only with the electric conductor, but also through wet boots or clothes (according as he is standing or sitting), with the ground or some other conductor, there is not the smallest chance of death by currents at such low voltages.

As regards continuous currents of electricity, I have not found records of many fatal accidents at voltages below 220 volts, but in one case a direct current at only 95 volts caused death, in another a current at 110 volts. The minimum number of milliamperes required to kill a human being under conditions favourable for killing is not known. Weiss calculates that from 70 to 90 milliamperes of an ordinary alternating current would be enough if the current went through the chest and heart; d'Arsonval states that much less than 100 milliamperes suffice to kill. Trotter found that continuous currents up to 35 milliamperes, though almost insupportably painful, were not fatal when passing from the hands to the feet. But when very large industrial currents are forced through the body by high voltages, we meet with the paradox that, while small currents may kill instantaneously, large currents are much less fatal. For example, the American electrocutions have shown that alternating currents of 5 or 8 amperes may pass for many seconds through the body without causing permanent arrest of the heart or respiration. In several recorded non-fatal cases of shock by alternating or three-phase currents at 10,000 volts, it is true that no measurements of the amperes passing through the victims were made, but it is reasonable to suppose that they may have amounted to several amperes. It is plain, then, that currents of a fraction of an ampere may cause sudden death by throwing the ventricles of the heart into fibrillary contraction, though much larger currents of several amperes do not act thus, and so are not fatal. But I do not know of any examples or experiments to show at what point or amperage the transition from small dangerous to large non-dangerous currents takes place.

So far as one can guess, in the absence of any experimental proof, it seems that a continuous current must be two or three times as strong as an alternating current, to kill a human being. So far as sudden death is concerned, electric currents are dangerous to man in proportion to the degree to which they tend to pass through the heart.

The prognosis in cases of severe electric shock has been very variously estimated. Cunningham (1899), for example, speaks of artificial respiration as "the only, and almost invariably futile, method in vogue in electrical accidents at the present day," for the resuscitation of persons apparently killed by electric shock. The opposite view is held by Lauffer (1912), who says "there are few cases of electrical accident where the victim cannot be restored from the electrical shock, if appropriate immediate efforts at resuscitation are instituted."

The treatment—artificial respiration by Schäfer's or Sylvester's methods—is still that advised by Priestley in 1767. The importance of getting to work with the artificial respiration without a moment's delay has often been emphasised by those who have had much experience of electrical accidents. No less important is the necessity for continuing artificial respiration until *it is certain* that death has occurred; nothing less than cooling of the body or the onset of *rigor mortis* should be considered to be evidence of death here.

DEATH BY LIGHTNING.

Up to the present time, meteorologists have furnished us with singularly little definite knowledge about the electrical properties of lightning strokes and the electrical quantities concerned in their production. They may be summed up as very strong electric currents of very brief duration and very high potential, containing thousands or possibily millions of foot-tons of energy. When human beings are struck, a part at any rate of this energy is converted into heat, producing various bodily lesions in most instances. Death by lightning-stroke is much commoner in most countries than it is in ours. In England and Wales the Registrar-General reported 124 fatal instances of lightning-stroke, 108 in men and sixteen in women, during the ten years 1901–10, a yearly average of only 12·4 deaths, or 0·36 per million living. In Hungary the annual death-rate from lightning is said to be sixteen per million living (Milham); in Styria and Carinthia about ten per million, in Prussia 4·4, in France and in Sweden three, in Belgium two, so far as the imperfect statistics available go (McAdie and Henry). In the United States of America the annual death-rate per million is high, about ten, in consequence of the frequency of thunderstorms on one hand, and of the large percentage of the inhabitants engaged in outdoor labour on the other; about 700 or 800 deaths from lightning were estimated to occur in the United States every year by Henry in 1900, in a population of seventy-six millions. Many more people are struck by lightning than are killed. For example, Jack records an instance in which a church was struck; 300 people were in it, 100 were injured and mostly made unconscious, thirty had to take to their beds, but only six were killed. Weber gives an account of ninety-two people struck in Schleswig-Holstein; ten were killed, twenty paralysed, fifty-five stupefied, and seven only slightly affected. In 1905 a tent with 250 people in it was struck, and sixty were left on the ground in various states of insensibility; one was killed outright, another breathed for some minutes before dying, the rest recovered. As many as eleven and eighteen persons have been killed by a single stroke of lightning. Vincent mentions a stroke that threw down 1200 and killed 556 out of a flock of 1800 sheep.

As to the exact way in which lightning causes death, some experiments of Prevost and Battelli, in which the discharges of induction coils and condensers were employed, seem to show that it is by central inhibition and cessation of the respiration in many cases, in others by cardiac fibrillation and stoppage of the heart. The bodies of persons killed by lightning exhibit no characteristic pathological changes except the production of burns and the curious subcuticular or subcutaneous stainings known as "lightning figures," that often imitate the fronds of ferns or leaves or branches of trees, and have given rise to a deal of baseless speculation as to their mode of production. Among the most interesting of the other and far rarer *post-mortem* lesions observed are lacerations of the soft tissues and fractures of the bones. The exact mechanism by means of which lightning lacerates tissues and fractures bones is obscure. In cases where the heel is lacerated and the os calcis comminuted, one may perhaps imagine that an extra development of heat and steam has taken place here, with the result that the electric discharge has, so to speak, blown its way out of the body. The example described by Clark and Brigham proves that enough heat may be developed in so deeply situated a bone as the orbital plate of the frontal bone to char it, so that it is not unreasonable to suppose that small steam explosions may result if the lightning develops a less degree of heat in a moist tissue. But it is not quite easy to imagine how the tibia and fibula could be broken, without showing any external injury, as in Penfold's case, if the fractures were caused by small steam explosions taking place inside these bones. Yet there is no alternative explanation to offer. For I do not think it is imaginable that any known forces of electric attraction or repulsion could exert enough violence to break bones. At any rate, the physicists appear to know nothing of electric forces of the magnitude that would be required here. In a few well-recorded instances which are extraordinary almost to the point of being incredible, strokes of lightning have effected amputations.

Unless sudden death follows, the probability that a person struck by lightning will recover is large; Dechambre collected 365 instances in which the immediate effects of the stroke were survived, and found that only fifteen of these victims died subsequently from late effects of the lightning. It seems to be very generally assumed that immediate treatment would improve the prognosis considerably, and that many of the people killed by lightning are only apparently dead, and still capable of recovery if properly treated during the next few minutes. I do not know of any statistical evidence to prove this point.

At the present day only general advice can be given, as the accumulated records have shown that no place above ground is completely protected against lightning. It is certainly safer to be indoors than out, and a large house is much safer than a shanty. The windows and doors of the room in which one is should be shut, and one should keep away from the walls, and particularly from the fireplace, because, when a chimney-stack is struck, the contents of the chimney and the fireplace are often blown out into the room and cause bodily injuries. A great many people have been struck in sheds and barns, especially when they have been near doors or windows, or in currents of air. Turley recommended the centre of a railway carriage at a distance from the engine as the securest place of all; Schefčik, a feather bed. To take refuge in the cellars merely to avoid a thunderstorm is not necessary as a routine, though in exceptional cases it may be advisable.

The advice given by various authors to persons caught out of doors in a thunderstorm is contradictory. It is probably unwise to take shelter in a shed unless one can get out of the way of doors, windows, and draughts while one is in it. A shed containing domestic animals is certainly more dangerous than the open. If one has to remain in the open, there are certain things that should be avoided at any cost. The first of these is the proximity of wire fences, because when such a fence is struck the electric discharge may be carried along the wires and cause death at a distance from the place actually struck. The second is proximity to such things as hedges, ponds, and streams, isolated trees, crowds of people, and herds of domestic animals. Crowds of people or animals seem to have a mild attraction for lightning, very possibly by virtue of the warmth and dampness they impart to the atmosphere immediately round them. It has often been said that to have had the clothes thoroughly wetted by rain and rendered conducting gives some protection to people who are struck by diverting the path and violence of the lightning from the body to the clothes. I have found seven well-recorded instances in which the effect of the stroke was to blow all, or practically all, the wetted clothes off the body, by the generation of steam as I believe. There can be no doubt that a part of the energy of the lightning was expended on the clothes in these cases, but three of the seven victims were killed notwithstanding. So the protection of wet clothes cannot be considered at all complete.

So far as treatment is concerned, persons struck and apparently killed by lightning should at once be given plenty of fresh air, their clothes should be loosened, and artificial respiration by Schäfer's or Sylvester's method should be applied and should be continued until either recovery occurs or cooling of the body and *rigor mortis* show conclusively that death has taken place. In the medical writings of from fifty to two hundred years ago one often sees bleeding recommended, and this might well be of service in those cases of lightning-stroke in which the heart goes on beating while the respiration stops. If it were immediately—within a few minutes—available, to give strong electric shocks to the præcordia would be well worth trying in desperate cases. As regards other remedies—such as stimulants in all forms, hot or cold applications, the inhalation of pungent vapours—very many have been recommended, but none seem to have met with any success.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SHEFFIELD.—Mr. W. G. Fearnsides, fellow and lecturer in natural sciences at Sidney Sussex College, and demonstrator in petrology in the University of Cambridge, has been appointed to the Sorby chair of geology.

ACCORDING to an announcement in the "Political Notes" of *The Times*, there is reason to believe that the Government has abandoned the intention of introducing this session the Education Bill which was to have embodied the scheme under consideration by Lord Haldane's Cabinet Committee. Every effort is being made to lighten the Government programme so that Parliament may be prorogued at a reasonable date in August.

IT is announced that their Majesties intend to invite to a garden-party at Buckingham Palace on Saturday, July 19, representatives of the teaching profession in London. We understand that invitations will shortly be issued to responsible head-teachers and principals of schools, institutes, and colleges of every type constituting the public system of education in the county of London. A special choir of children selected from public elementary schools will sing before their Majesties.

IN support of the foundation of a Western University in Central China, a meeting of members of Parliament was held in the House of Commons on June 26. Canon Lord William Gascoyne-Cecil said that nothing is being asked for out of the pocket of the British taxpayer. The suggestion is that the British Government should forgo part of the Boxer indemnity. We learn from *The Times* that it was pointed out that the Boxer indemnity claimed by Great Britain amounted to more than 7,000,000*l*., and of that amount only 199,000*l*. has been paid. A sum of 250,000*l*. spread over a long period would meet the cost of the new University. A motion that a deputation be appointed to urge upon the Prime Minister the desirability of a Government grant, either out of the Boxer indemnity fund or otherwise, towards the establishment of the proposed University was agreed to.

THE Board of Education has issued (Cd. 6866) the regulations, which will come into force on August 1, for university tutorial classes in England and Wales. The Board will be prepared to make special grants in aid of part-time courses in subjects of general as distinct from vocational education, given under the educational supervision either of a university or university college, or of an educational body containing representatives of such places of higher education. The university or supervising body must be responsible for the framing of the syllabus, and the selection of a suitable tutor; and the instruction must aim at reaching, within the limits of the subject covered, the standard of university work in honours. The course must extend for each class over a period of not less than three years, and must occupy at least two hours a week for twenty-four weeks in each year, at least one-half of the time being devoted to class work.

IN the issue of *Science* for June 13 further large gifts to higher education in the United States are announced. Mr. Andrew Carnegie has undertaken to provide 200,000*l*. for the medical department of Vanderbilt University. Of this sum 40,000*l*. is to be given to the University immediately for the erection and equipment of laboratories. The income from the remaining 160,000*l*. is to be paid annually for the support of the department through the Carnegie Corporation. A condition of the donation provides that the direction of the educational and scientific work of the department shall be committed by the board of trustees to a small board of seven members, three of whom shall be eminent in medical and scientific work. Messrs. J. B. and B. N. Duke have given 160,000*l*. more to Trinity College in North Carolina. The college has thus secured the 30,000*l*. promised by the Rockefeller Foundation, and has added 200,000*l*. to its endowment. Governor Sulzer has signed a Bill granting 50,000*l*. for a building for the State College of Agriculture at Syracuse University.

THE report for 1913 of the council of the City and Guilds of London Institute has now been published. In it is passed in review the work of the City and Guilds (Engineering) College, the City and Guilds Technical College, Finsbury, the South London Technical Art School, the Department of Technology, and the Leather Trades School. The audited accounts and balance-sheet of the institute are given, and the reports of the heads of the various colleges and schools are included. During the past session the Department of Technology registered 4552 classes in the United Kingdom in 331 towns. These classes were attended by 53,999 students; this number represents, however, only a proportion of the total number of students in attendance at courses of technical instruction largely influenced by the work of the department. The examinations of the department were held in seventy-five technological subjects, for which 22,111 candidates were presented in the United Kingdom alone. While the total number of candidates shows a decrease on the number for 1911, the proportion of passes in the examinations has, on the contrary, risen by 4 per cent., which suggests that the fall in the number of candidates is largely due to the exclusion of a number of insufficiently prepared students from the examinations.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 19.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir James **Dewar**: Atomic specific heats between boiling points of liquid nitrogen and hydrogen.—I. The mean atomic specific heats at 50° absolute of the elements a periodic function of the atomic weights.—Hon. R. J. **Strutt**: An active modification of nitrogen produced by the electric discharge. V. (1) An improved practical method of preparing and storing nitrogen for the experiments is described. (2) It is shown, notwithstanding criticisms of certain other experimenters, that the presence of traces of oxygen in the nitrogen used is not essential, or even favourable, to the phenomena. The nitrogen used, purified by cold phosphorus, does not contain oxygen to the extent of one part in 100,000. Passing it over red-hot copper in addition makes no difference. The intentional addition of oxygen does harm; 2 per cent. obliterates the effects altogether. Hydrogen and carbon dioxide as impurities are much less harmful, but traces even of water vapour have a very bad effect. (3) Nitrides are formed by the admixture of active nitrogen with vapour of mercury, cadmium, zinc, arsenic, sodium, and sulphur. These are decomposable by water or potash solution, yielding ammonia. (4) Carbon disulphide yields a blue polymeric nitrogen sulphide, and polymeric carbon monosulphide. Chloride of sulphur gives ordinary yellow nitrogen sulphide. Stannic chloride and titanium tetrachloride also yield solid products. In the latter case nitrogen was proved to be present. (5) All organic compounds tried, except carbon tetrachloride, yield hydrocyanic acid freely, but not cyanogen, as was proved by chemical tests. When chlorine is present, cyanogen chloride is formed. Benzene yields (almost certainly) cyanobenzene. (6) The intensity of the cyanogen spectrum with organic compounds is no index of the quantity of hydrocyanic acid being formed. Preponderance of the red cyanogen bands is associated with cyanogen chloride or bromide. On a general view of the evidence, there does not appear to be any definite connection between the development of spectra by active nitrogen and the chemical actions in progress.—Dr. J. A. **Harker** and Dr. G. W. C. **Kaye**: The electrical emissivity and disintegration of hot metals. Preliminary experiments have been carried out on the volatilisation and electrical emissivity of a number of metals, mostly in nitrogen at reduced pressures. The metals were heated by alternating current and no applied potential was employed. (1) The emission of positive electricity occurs at temperatures from about 1000° to 1400° C. For metals which melt within this range, a sudden and marked increase in the positive current often occurred at the liquefying point—due, probably, to the sudden release of occluded gas. (2) Oxygen appears to augment the positive current. (3) At higher temperatures, negative electricity predominates and increases rapidly with the temperature. The negative current attained with iridium at the melting point was 80 milliamperes, with tantalum at 1670° C. 220 microamperes, with iron at the melting point 90 microamperes. In the case of carbon in air at atmospheric pressure, an ionisation current of $3\frac{1}{2}$ amperes was obtained. (4) The negative current at moderate pressures appears to be largely increased if the conditions are such that considerable sputtering of the metal occurs. (5) The negative currents are probably a consequence of chemical reaction between the metal and the surrounding gas. (6) Carbon becomes plastic in the neighbourhood of 2500° C. At such temperatures it also readily sublimes.—Dr. A. O. **Rankine**: A method of measuring the viscosity of the vapours of volatile liquids, with an application to bromine. In this method of determining viscosities the rate of transpiration of the vapour through a capillary tube is controlled by the vapour pressures of the liquid itself, a difference of pressure being established in the process of virtually distilling the liquid through the capillary. The pressures can be estimated without the use of mercury gauges—a state of affairs especially desirable in the case of the halogens. The viscosities of unsaturated bromine vapour over the approximate range 10° C. to 250° C. have been measured, and, except at the lowest temperatures, are found to agree well with Sutherland's formula, notwithstanding the fact that all the temperatures are below the critical.—E. E. Fournier **d'Albe**: The efficiency of, selenium as a detector of light. The efficiency of a selenium preparation used as a detector of light is defined as the amount of additional conductivity imparted to it by the unit of incident light. Since many factors affect the efficiency of a given selenium bridge, standard conditions are chosen, chief among them being an illumination of one lux. The law of light action is studied, and the total effect is shown to be proportional to the square root of the incident energy, while the instantaneous effect is proportional to the energy. This is verified down to an illumination of 0·00001 metre-candle. It is shown that selenium is the most efficient light detector known, that it is capable of discriminating minute differences of luminous intensity far beyond the capacity of the eye, and that, with suitable means of detecting minute currents, it should offer a means of testing the quanta theory of light by direct experiment.—A. E. **Oxley**: The Hall effect in liquid electrolytes. Experiments have been made on aqueous solutions of copper sulphate, silver nitrate, cadmium sulphate, and on copper sulphate gel. Each substance was placed in a small cell of glass or mica, and was subjected to a uniform magnetic field. A Paschen galvanometer was used to measure the transverse potential difference. In a uniform magnetic field this transverse potential difference is due partly to a true Hall effect (depending on the difference of the ionic mobilities), and partly to a concentration Hall effect (depending on the sum of the ionic mobilities). The latter effect is primarily the one which has been measured in this research, and the former, which is smaller, is included. Eight experiments have been made, and the transverse potential differences, which changed sign on reversal of the magnetic field, have been found to agree with the calculated values. The relation between the transverse potential difference and the intensity of the magnetic field, for an aqueous solution of copper sulphate, is linear.—Prof. W. B. **Morton**: The displacements of the particles and their paths in some cases of two-dimensional motion of a frictionless liquid.—S. **Chapman**: The diurnal variations of the earth's magnetism produced by the moon and sun.—Prof. H. A. **Wilson** and Marjorie **Wilson**: The electric effect of rotating a magnetic insulator in a magnetic field.—A. **Hopwood**: The magnetic materials in claywares. The author has found that white, cream, grey, yellow, buff, red, or brown claywares are feebly or moderately magnetic owing to the presence of unfused grains of unchanged ferruginous minerals and fused globules of complex ferruginous silicates; while flashed, brindled, or blue claywares are always strongly magnetic owing to the presence of complex ferruginous silicates and finely disseminated magnetic oxide of iron. The origin of the complex ferruginous silicates in claywares is quite different from that of the magnetic oxide of iron. While the latter is produced either by the orientation of the magnetite, originally present in the clays, or by the reducing action of the kiln gases on the precipitated or colloid oxides, hydroxides, or carbonates of iron disseminated throughout the clays, the former are produced by the fusion of the granular or concretionary ferruginous minerals, *i.e.* iron pyrites, siderite, hæmatite, magnetite, biotite, &c., occurring in the clays with the surrounding matrix.—A. **Hopwood** and C. **Weizmann**: Synthesis of the anhydrides of α-aminoacyl glucosamines.—H. S. **Jones**: The flexure of telescope mirror-discs arising from their weight, and its influence upon resolving power.—Prof. W. H. **Young**: Fourier series and functions of bounded variation. In the present communication it is shown that in a number of fundamental theorems the derived series of the Fourier series of a function of bounded variation may take the place of the Fourier series of a summable function, and this even when the function of bounded variation is not continuous, or still less an integral. In particular, the coefficients of such a series may be used as convergence factors, with results which approximate to, or are even identical with, those obtained when the convergence factors are the coefficients of a Fourier series. The use of these convergence factors transforms, in fact, when the function of bounded variation is odd, a Fourier series into a Fourier series, and an allied series into a Fourier series when the function of bounded variation is even.—Prof. W. H. **Young**: A condition that a trigonometrical series should have a certain form. In the present communication a necessary and sufficient condition that a trigonometrical series should have a form in which its coefficients are expressible in terms of Stieltjes integrals with respect to a function of bounded variation is obtained.—Prof. W. H. **Young**: Trigonometrical series the Cesaro partial summations of which oscillate finitely.

PARIS.

Academy of Sciences, June 25.—M. F. Guyon in the chair.—M. **d'Arsonval**: Some remarks on the papers read at the meeting at Toulouse of the Congrès national du Froid.—J. **Guillaume**: The present sunspot minimum. During the seventy-three days from April 12 to June 23 no spot has been noted on the sun's disc.—A. **Tian**: An experimental determination of the light energy absorbed in a photochemical reaction. A description of a null method based on the use of a thermopile. In the photochemical decomposition of hydrogen peroxide there is no proportionality between chemical action and the energy absorbed, even when the light used contains no infra-red rays.—Jacques **Carvallo**: A photo-electric phenomenon presented by liquid sulphur dioxide. In a preceding communication it has been shown that liquid sulphur dioxide submitted to a constant potential difference between two platinum electrodes is traversed by a current which tends to a constant limit. This phenomenon is sensitive to the action of light: each exposure causes a sudden decrease in the current. The effects have been proved to be due to ultra-violet rays.—Thaddée **Peczalski**: A relation between the law of compressibility of gases and the coefficients of expansion.—André **Léauté**: The high-frequency oscillations in very short electric arcs. From the experiments described a new position is proposed for safety fuses in connection with high-tension circuits.—P. Th. **Muller** and R. **Romann**: The electrolytic dissociation of a salt, governed by the mass law. A study of the conductivity of solutions of piperidine cyanacetate. For this salt the ionisation, measured by the conductivity of the solution, is governed by the law of mass action.—Marcel **Boll**: The photochemical decomposition of solutions of oxalic acid in presence of uranyl nitrate. The electrical conductivity measurements showed that the reaction was unimolecular, the solution being illuminated with monochromatic light. The energy absorbed during the reaction is much lower than the quantum of Einstein.—Marc **Landau**: The phenomenon of photocatalysis. All compounds of uranium possess marked photocatalytic properties; there is no relation between the values for the photocatalytic power and the radioactive power of these compounds. Catalysis takes place even when the uranium compounds used as catalysers are insoluble.—E. **Rengade**: The melting points, specific heats, and heats of fusion of the alkali metals. Measurements of these three constants are given for sodium, potassium, rubidium, and cæsium. The value of L/T was about 1·68 for all four metals.—Léon **Guillet** and Victor **Bernard**: Variations of the resilience of copper and of some of its alloys as a function of the temperature. Curves are given for copper, six brasses, cupro-nickel, German silver, and two aluminium bronzes.—René **Dubrisay**: The neutralisation of chromic acid.—Paul **Pascal**: Remarks on the additivity of the physical properties in the organometallic series.—A. **Colani**: Study of the chloro-oxalate of thorium.—J. B. **Senderens**: Oxidation of the alcohols under the influence of heat alone. Ethyl, *iso*butyl, and *iso*amyl alcohols are rapidly oxidised by air at temperatures between 380° C. and 450° C. Ignorance of this fact has led to catalytic properties being erroneously assigned to certain substances.—G. **Favrel**: A new series of *iso*pyrazolones.—G. **André**: The relation of the mineral acids and bases in plant tissues.—C. **Gerber**: The latex of *Ficus coronata*, an incomplete plant pancreatic juice, without amylase, and with proteolytic diastase predominating. Comparison with *Ficus carica*.—De **Gironcourt**: The Gironcourt Expedition, 1908–9. The botanical results. Specimens were collected in Dahomey, Nigeria, Togo, and the Gold Coast.—Paul **Dop**: The cytology of the micropylar suckers of the albumen of *Veronica persica*.—M. **Guilliermond**: The formation of anthocyan in the middle of the mitochondria.—E. **Michel-Durand**: Variations in the carbohydrates of leaves in the course of development.—L. **Bordas**: Anatomical and histological considerations on the Malpighian tubes of some Orthoptera.—L. **Léger** and O. **Duboscq**: The evolutive cycle of *Porospora portunidarum*.—J. **Bridré** and A. **Boquet**: Anticlavelous vaccination with sensitised virus. Duration of the immunity: applications to vaccination.—A. **Trillat** and M. **Fouassier**: The contamination of milk by the typhoid bacillus through water. Milk is an extremely favourable medium for the development of the typhoid bacillus.—R. **Fosse**: The detection of urea in plants. Urea can be precipitated by xanthydrol in plant extracts, heating or concentration of the solution being unnecessary.—L. **Lagane**: The action of hydrogen peroxide on the amylase of human milk.—H. **Guilleminot**: The law of the biological action of filtered and non-filtered X-rays.—Carl **Renz**: The discovery of the Trias and the Jurassic in the Kopais Mountains (Central Greece).—J. **Vallot**: The velocity of glaciers in winter. The velocity of a glacier is the same in winter and summer.

BOOKS RECEIVED.

Das Radium und die Radioaktivität. By Dr. M. Centnerszwer. Pp. 96. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Protective Inoculation against Cholera. By W. M. Haffkine. Pp. 98. (Calcutta: Thacker, Spink and Co.; London: W. Thacker and Co.) 3 rupees, or 4*s*. 6*d*. net.

L'Aviation. By Prof. P. Painlevé, Prof. E. Borel, and C. Maurain. Sixième édition. Pp. viii+298. (Paris: F. Alcan.) 3.50 francs.

Geologischer Führer in die Umgegend von Halle a.d.S. By Prof. H. Scupin. Pp. viii+142. (Berlin: Gebrüder Borntraeger.) 2.60 marks.

Text-Book of Zoology. By H. G. Wells and Dr. A. M. Davies. Seventh Impression (sixth edition). Revised by J. T. Cunningham. Pp. viii+487. (London: W. B. Clive.) 6*s*. 6*d*.

Geological Survey of Alabama. Monograph 8: Economic Botany of Alabama. Part i., Geographical Report on Forests. By R. M. Harper. Pp. 228. (Alabama: The University.)

Elementary Tropical Agriculture. By W. H. Johnson. Pp. xi+150. (London: Crosby Lockwood and Son.) 3*s*. 6*d*. net.

The British Bird Book. Edited by F. B. Kirkman. Section XI. Pp. 189–404+plates. (London and Edinburgh: T. C. and E. C. Jack.) 10*s*. 6*d*. net.

A Laboratory Guide to the Study of Parasitology. By W. B. Herms. Pp. xv+72. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*. net.

The Chemistry of Rubber. By B. D. Porritt. Pp. vii+96. (London: Gurney and Jackson.) 1*s*. 6*d*. net.

Orthopædics in Medical Practice. By Prof. A. Lorenz and Dr. A. Saxl. Translated by Dr. L. C. P. Ritchie. Pp. xvi+288. (London: J. Bale, Ltd.) 7*s*. 6*d*. net.

DIARY OF SOCIETIES.

FRIDAY, JULY 4.

GEOLOGISTS' ASSOCIATION, at 8.—A Geological Reconnaissance on the East Coast of the Victoria Nyanza: Dr. Felix Oswald.

MONDAY, JULY 7.

ARISTOTELIAN SOCIETY, at 8.—Annual Meeting.—The Philosophy of Probability: Dr. A. Wolf.

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THE DAVY-FARADAY RESEARCH LABORATORY

OF THE

ROYAL INSTITUTION,

No. 20 ALBEMARLE STREET, LONDON, W.

DIRECTOR

Professor Sir JAMES DEWAR, M.A., LL.D., D.Sc., F.R.S.

This Laboratory was founded by the late Dr. Ludwig Mond, D.Sc., F.R.S., as a Memorial of Davy and Faraday, for the purpose of enabling properly qualified persons to conduct Chemical and Physical Research.

Workers admitted are entitled to the use of the extensive chemical and physical apparatus belonging to the Laboratory.

The Director may, subject to the approval of the Laboratory Committee, supply special chemicals, or authorise the Mechanician to construct special apparatus for individual investigators.

MICHAELMAS TERM.—Monday, October 6, to Saturday, December 20.

LENT TERM.—Monday, January 12, to Saturday, April 4.

EASTER TERM.—Monday, April 27, to Saturday, July 25.

Applications for admission to the Davy Faraday Research Laboratory to be addressed to the Assistant Secretary, Royal Institution, No. 21 Albemarle Street, London, W.

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The Governing Body of the Municipal School of Technology, Manchester, offers five RESEARCH SCHOLARSHIPS in TECHNOLOGY, each of the value of £40 per annum, with fees remitted, tenable for one year. Application for these Scholarships must be made not later than July 14, 1913, to the Registrar, from whom forms of application and full particulars may be obtained.

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CHEMISTRY COURSES.

A Prospectus containing full particulars of the Lecture and Laboratory Courses preparing for both the ordinary and Honours Degrees in Chemistry will be forwarded on application to the Registrar.

Applications for admission to the Research Laboratories should be made to the Director of the Chemical Laboratories.

COUNTY OF NORTHUMBERLAND.

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The Governors invite applications for the position of HEADMASTER of the WALLSEND SECONDARY SCHOOL and TECHNICAL INSTITUTE, now in course of erection. The gentleman appointed will be required to act as Headmaster of the Boys' Department of the Secondary Day School (accommodation 140), and to supervise evening class instruction in Applied Science. The appointment will commence at a time to be mutually arranged not later than March, 1914.

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Salary £300, rising by increments of £10 to £375, together with a sum not exceeding £25 to meet a like sum paid by the Headmaster in respect of premiums for a deferred annuity. Canvassing directly or indirectly will disqualify.

Form of application, which must be returned by August 30, 1913, may be obtained by sending stamped addressed envelope to the undersigned.

C. WILLIAMS,
Secretary to the Education Committee.

The Moothall,
Newcastle-on-Tyne.

PRELIMINARY NOTICE.

SOUTH WALES & MONMOUTHSHIRE SCHOOL OF MINES,

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The FIRST SESSION of the new School of Mines—founded by the Coal Owners of the South Wales and Monmouthshire Coalfield—for the training of all grades of Colliery Officials, will commence on MONDAY, OCTOBER 6, 1913.

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Salaries rise in accordance with the County Scale, and duties commence in September next in each case.

Applications giving full particulars of training and experience, together with copies of three testimonials and names of three referees, are to reach me not later than July 19.

G. H. WOOLLATT, Principal.

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(FACULTY OF SCIENCE.)

LECTURESHIP IN GEOLOGY AND GEOGRAPHY.

The Council invites applications for the post of LECTURER in GEOLOGY and GEOGRAPHY. Stipend £200 per annum.

Applications, accompanied by six copies of testimonials, or such other credentials as the candidates may prefer to offer, should be sent to the undersigned on or before July 21.

The successful candidate will be required to enter on his duties at the commencement of the session, October 7.

Further particulars may be obtained from

GEO. H. MORLEY, Secretary.

UNIVERSITY COLLEGE OF WALES, ABERYSTWYTH.

(*A Constituent College of the University of Wales.*)

DEMONSTRATORSHIP IN CHEMISTRY.

The Council invite applications for the post of DEMONSTRATOR and ASSISTANT LECTURER in the DEPARTMENT of CHEMISTRY at the above-named College. Salary £120 per annum.

Applications, together with testimonials, must reach the Registrar not later than Friday, September 12, 1913.

Full particulars may be obtained from the undersigned.

J. H. DAVIES, M.A., Registrar.

THURSDAY, JULY 10, 1913.

ATOMS AND MOLECULES.

Les Atomes. By Prof. Jean Perrin. Pp. xvi + 296. (Paris: Félix Alcan, 1913.) Price 3.50 francs.

IN these days, when such notable and extensive advances are being made in nearly all fields of physical research, it is extremely desirable that the results which mutually bear upon one another should from time to time be collected together and recorded in more or less popular language. If, in addition, a leading expert can be persuaded to undertake the record, the event of its publication is still more to be welcomed. Prof. Perrin is the ideal author for a book on atoms and molecules. He has virtually made them visible and established their reality, and it is scarcely too much to say that his work on Brownian movement is the most notable of recent physical researches.

It is not always that the brilliant experimentalist is an equally brilliant exponent, but in the present case it is true, and the book makes fascinating reading. It must not be supposed that Prof. Perrin has confined his attention to the particular sphere of work with which his name is so intimately associated. Naturally enough, the details of theory and experiment are treated more completely in those chapters which are mainly records of the author's work. But the book as a whole has a broad outlook, and the atomic theory is considered from many different points of view and in the light of all the recent developments of the subject.

The first two chapters are devoted to a historical survey of the chemical and physical sides of the atomic theory and the early methods of estimating the size and number of the atoms. Then follow the chapters on Brownian movement previously referred to, in which the author shows how it is possible by four distinct methods to measure the atoms, with remarkably consistent results. The later chapters on opalescence, the quantum theory, and radio-activity have the same end in view, and in conclusion the author compiles the values obtained by thirteen different methods for Avogadro's number. A quotation from the author is the best comment on these noteworthy results.

"On est saisi d'admiration devant le miracle de concordances aussi précises à partir de phénomènes si différentes. D'abord qu'on retrouve la même grandeur, pour chacune des méthodes, en variant autant que possible les conditions de son application, puisque les nombres ainsi définis sans ambiguïté par tant de méthodes coïncident, cela donne à la realité moléculaire une vraisemblance bien voisine de la certitude."

Chapter vii. is one of special interest. In it the author deals with the determination of e, the atom of electricity, by the method of falling drops. He takes the view that the accuracy claimed by Millikan for his measurements is not justified on account of the magnitude of the correction to Stokes's law which has to be applied, and produces evidence which he regards as removing the well-known discrepancy between his own and Millikan's estimates. It remains to be seen whether Prof. Millikan assents to this view.

THE CULT OF THE THUNDERSTONE.

The Thunderweapon in Religion and Folklore. A Study in Comparative Archæology. By Dr. Chr. Blinkenberg. Pp. xii + 122. (Cambridge University Press, 1911.) Price 5*s.* net.

THIS little book forms an interesting addition to the archæological and ethnological series for which anthropologists are indebted to the Cambridge University Press. The author shows much erudition and industry in his search for specimens illustrating the cult of thunderstones which are preserved in the museums of England and the Continent. He has explored the voluminous literature of the subject, and he has added a series of illustrations which add much to the scientific value of the monograph.

His theory assumes that the cult of the thunderstone was an element of human culture which, at an early date, that is to say, in the Stone age, was gradually spread from people to people over a great part of the world; that it appears in the early Ægean culture; that the ideas of tabu or sanctity attaching to these stones indicate the rise of the belief from primitive conceptions of nature and religion. In other words, he supposes that as early as the Stone age men compared the effects of the lightning-stroke to that of the axe wielded by primitive man, and that this explanation accounts for the superstition in most parts of the world.

Various difficulties, of which the author is aware, prevent the acceptance of this theory of origins. The most important is that the superstition has not been traced among those races which possessed a Stone age culture down to modern times—the peoples of Australia, Oceania, and North America while in South America, to say the least, the evidence is weak. On the other hand, it is common in Africa, among races which have no such theory of the origin of objects which they supposed to be divinely produced. These facts being admitted, a different explanation suggests itself as being more probable. Such things usually come to light after torrential rains, and are thus naturally attributed to the thunder which accompanies the storm; and thus, besides flint axes, things like belemnites, fossil echini, and other quaintly shaped stones come to be revered like lithic artefacts.

It is also very doubtful if Mjölnir, the hammer of Thor, or the double-axe of Crete come within this category. The former was not a stone, but a forged metal axe, and the sanctity of the latter was possibly due to its use as a sacrificial implement. Poseidon's trident, again, was more probably the fish-spear which is the natural weapon of a sea-god.

In short, thunderstones, sacred fossils, sacred axes, and tridents may have their origin in general animistic conceptions, and their cult need not necessarily have arisen in any single centre or from any one train of thought. However this may be, the facts which the author has collected form a useful contribution to the study of primitive beliefs.

PURE AND APPLIED CHEMISTRY.

(1) *Problems in Physical Chemistry with Practical Applications.* By Dr. E. B. R. Prideaux. Pp. xii + 311. (London: Constable and Co., Ltd., 1912.) Price 7*s.* 6*d.* net.

(2) *An Introduction to the Physics and Chemistry of Colloids.* By Emil Hatschek. Pp. ix + 94. (London: J. and A. Churchill, 1913.) Price 2*s.* 6*d.* net.

(3) *Exercises in Gas Analysis.* By Dr. Hartwig Franzen. Translated from the first German edition (with corrections and additions by the Author) by Dr. Thomas Callan. Pp. vii + 120. (London: Blackie and Son, Ltd., 1913.) Price 2*s.* 6*d.* net.

(4) *Theorie und Praxis der Grossgasindustrie.* By Rudolf Mewes. Band 1. Hälfte 1. Pp. xx + 403. (Leipzig: H. A. Ludwig Degener; London: Williams and Norgate, n.d.) Price 18*s.* net.

(5) *Lehrbuch der Thermochemie und Thermodynamik.* By Prof. Otto Sackur. Pp. viii + 340. (Berlin: Julius Springer, 1912.) Price 12 marks.

(6) *A Foundation Course in Chemistry.* For Students of Agriculture and Technology. By J. W. Dodgson and J. Alan Murray. Pp. x + 244. (London: Longmans, Green and Co., 1913.) Price 3*s.* 6*d.* net.

(7) *Qualitative Determination of Organic Compounds.* By J. W. Shepherd. Pp. xvi + 348. (London: W. B. Clive, 1913.) Price 6*s.* 6*d.*

(1) DR. PRIDEAUX has compiled a book of problems to serve as exercises for students in physical chemistry. The students who have worked through these will not be able to complain that they have not been exercised sufficiently, as the examples selected are very numerous and by no means all easy. They are, however, selected directly from the original literature, and so require the student to give real solutions to real problems, instead of the sham answers to fictitious questions which so frequently disfigure books of chemical calculations. The form in which this excellent material has been published is much less satisfactory. The table of contents suggests that the volume is composed of eight chapters, but these do not appear in the text. The reader is informed on each of the 300 pages that the book he is studying is called "Problems in Physical Chemistry," but no hint is given as to the topic that is dealt with on the pages at which the book is opened. The eight chapters run on continuously, and almost the only way to discover where one chapter ends and another begins is to turn back to the table of contents, for the chapters are not even allowed the luxury of beginning at the head of a fresh page. As no index has been supplied, the contents of the book are far less accessible than they need be to a reader who does not wish to work right through the book from beginning to end.

(2) A somewhat similar complaint may be made in reference to the reprint of Mr. Hatschek's articles on colloids. These are divided into ten chapters, but the chapter-divisions do not correspond in every case with the natural divisions of the subject, and subject-headings are not given, so that the classification of the material is not immediately obvious. This defect is, however, very largely remedied by the provision of a very detailed table of contents and two indexes. The book has the great merit of presenting in a simple and readable form all the leading points of a difficult and little-known subject. It may be commended without hesitation to the many readers who at the present day are being compelled by the pressure of technical or scientific problems to acquire some knowledge of "colloid chemistry."

(3) The English translation of Dr. Franzen's "Gas Analysis" forms a very useful introduction to the subject. Directions are given for carrying out forty-two exercises. Thirty-three of these have to do with the analysis of gases. The remainder, which are collected under the heading

of "Volumetric Gas Analysis," are not exercises in the volumetric as contrasted with the gravimetric analysis of gases, but have to do with the analysis of solids and liquids by measuring the volumes of gas set free from them. In this section, for instance, are described the methods of estimating nitrates by the Lunge nitrometer and analogous processes. The book is presented in an attractive form, and carries out admirably the purpose of the author and translator to provide an introduction to the larger standard works on gas analysis.

(4) The German treatise on the theory and practice of the gas industry is a large work of which the present volume constitutes "I. Band, I. Hälfte." It includes the historical development of the principles of mechanics and physics, and the fundamental laws of thermodynamics. The subjects treated include isothermal and adiabatic compression, change of state, evaporation and boiling, viscosity of gases and vapours, specific heats, entropy of water-vapour and vapours used in refrigeration, radiation and conduction, flow of liquids, vapours, and gases. The chemist or engineer who is called upon to handle gases on a large scale will find in this treatise all that he is likely to require in the way of scientific preparation for his work.

(5) Prof. Sackur's "Text-book of Thermochemistry and Thermodynamics" deals with the fundamental laws of heat and of thermodynamics, which are then applied to many of the chief problems of physical chemistry. Thus we find chapters devoted to the theory of solutions, including van't Hoff's equations for osmotic pressure, and to chemical equilibrium based upon the equations of Helmholtz and of van't Hoff, and applied, for instance, to calculate the heat of ionisation from the change of the ionisation-coefficient with temperature. There are also chapters on the applications of thermodynamics to electrochemistry, thermoelectricity, and capillarity. The last chapters deal with radiation and with Nernst's "heat-theorem."

(6) The "Foundation Course in Chemistry" of Messrs. Dodgson and Murray is a well-written book of rather exceptional character. Special attention is paid to topics which have an interest for agricultural students, but this is by no means a drawback from the point of view of the general reader, as it gives an air of reality to the whole treatment of the subject. Structural formulæ are freely used for inorganic as well as for organic compounds, and a long chapter is given up to the chemistry of aliphatic compounds under the title "Paraffins and their Derivatives." The chapter on general principles gives a clear exposition of the doctrine of equivalents, but is scarcely an adequate exposition of the atomic theory, as Avogadro's hypothesis, which is the real basis of the modern system of atomic weights, is postponed to a later chapter, and is there treated only in the most incidental manner.

(7) The modern system of examinations is responsible for the development of a form of qualitative organic chemistry in which attempts are made to determine the nature of organic compounds without carrying out a combustion or quantitative analysis of any sort. This type of organic chemistry is only distantly related to the requirements of scientific or technical research, and has only a very limited range of usefulness. But if the student is aware of the supreme necessity of quantitative work there is little harm in allowing him to get some practice in recognising the qualitative properties of the chief radicles. Mr. Shepherd's book gives a scheme whereby the most important groups of organic compounds may be identified by qualitative tests; the scheme has been in use for some years, and has thus been adequately tested by actual work in the laboratory.

OUR BOOKSHELF.

A Text-book of Experimental Metallurgy and Assaying. By A. R. Gower. Pp. xiv+163. (London: Chapman and Hall, Ltd., 1913.) Price 3*s*. 6*d*. net.

The new edition of this book conforms to the syllabus of the Lower Examination in practical metallurgy of the Board of Education. The first portion of the book consists of a series of experiments and explanations to illustrate the reactions occurring in various metallurgical operations, while the second part deals, in quite a satisfactory manner, with elementary assaying. It would have been an advantage if the book gave a little more guidance to the beginner, for very often he does not realise the economic character of metallurgy. For instance, a student sometimes thinks that as sodium carbonate is used in the laboratory as a flux for silica, therefore it would be charged into a blast-furnace smelting copper ores when silica has to be removed. The first chapter of this book may give some students an impression of this kind, for the substances classed as used in metallurgical operations are not all commonly so employed, although frequently used in experimental metallurgy and assaying. Then, again, in the chapter "Formation of Alloys," the theoretical quantities of the metals have been given, and no allowance made for loss in the case of volatile metals.

During the past twenty-five years the book has proved of use, and the present edition should be of assistance to those preparing for the Board of Education examination, and if the exercises are performed under the supervision of a teacher, none of its minor defects will cause the beginner to gain wrong impressions.

Ministère de l'Agriculture. Direction Générale des Eaux et Forêts. 2e partie. Eaux et Améliorations Agricoles. Service des Grandes Forces hydrauliques dans la Région des Alpes. Résultats des Etudes et Travaux à la Fin de 1911. Tome v., 1912. Pp. 530.

THE present volume is the fifth of the series published by the French Ministry of Agriculture since the inauguration of the Service of the Great Hydraulic Forces in Alpine regions, and it brings the account of operations down to the end of the year 1911. Of the 530 pages of which the volume consists, 487 are devoted to a tabulation of the results obtained from observations in the basins of the Arve, the Fier, the Isère, and the Drôme. A series of nine charts also accompanies the report, covering the regions of the Arc, the Breda, the Durance, and the Guil.

It is interesting to note the expedients and devices by which an investigation, demanding for its most effective development the employment of expert scientific observers, has been enabled to be carried on to a large extent by voluntary workers and local auxiliaries, for the most part untrained and indifferently coordinated. Such agencies in many cases have had to be relied upon for the collection of data, and as there is a constant change of personality in the assistants, the difficulties in the way of securing trustworthy records are sufficiently obvious.

"However," concludes the prefatory note, "in spite of defects, of which we more than anyone are conscious, we are convinced that the study of hydraulic forces, so far as circumstances permit, constitutes none the less a real utility"—and a cursory glance through the pages of statistical matter, carefully annotated and compiled, bears incontestable witness to the patient labour and exactitude of those engaged in the French hydrographical service and of M. de la Brosse, its chief engineer.

Weather Bound. By R. T. Smith. Pp. 319. (Birmingham: Cornish Bros., Ltd., n.d.) Price 15*s*. net.

THE author gives, in great detail, summaries of results of twenty-seven years' observations at five stations situated to the west of Birmingham, in a series of tables and diagrams occupying 170 pages. He adds a diary, "Weatherwise and Otherwise," for the same period, which occupies sixty pages, and explanatory text (seventy-two pages). He also gives a diagram of the normal course of the meteorological elements throughout the year, which is unintelligible owing to want of explanation. The amount of industry displayed is worthy of praise, and most of the tables appear to contain climatic data of real value, but the author's exposition cannot be recommended to the attention of serious students of meteorology.

R. C.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Radio-activity and the Age of the Earth.

IN his letter in NATURE of June 26, Dr. Schiller quotes with disapproval Mr. Holmes's deduction that the "heavy metallic core" of the earth "must be completely destitute of radium"; for this deduction, in Dr. Schiller's opinion, "involves the improbability that the heaviest metal of all, uranium, has not gravitated to the 'metallic core,' and does not explain why this core should be destitute of radio-active substances."

In the next paragraph, however, Dr. Schiller suggests a possible escape from the difficulty with the words, "it is possible that under the physical conditions obtaining in the interior uranium does not dissociate, or does so much more slowly."

Last autumn, as a sequel to certain speculations into the effects of pressure on the mineralogical constitution of the earth's crust at great depths, I was led to a consideration of this very question of the dissociation of elements when subjected to the high temperatures and pressures that prevail at such depths.

So far as I was able to discover, no determination of the specific gravity of radium had then been made, presumably for lack of sufficient material; but, judging from its chemical relationship with barium, the atomic volume of radium must be much greater than that of uranium. Heat is known to be evolved during the disintegration of radium, so that the breakup of this element is an exothermic change. I am writing this letter whilst travelling, and am, consequently, unable to verify my impression that heat is also evolved during the conversion of uranium into radium. But in any case, the passage of uranium into radium may be expressed in a general way by some such equation as the following:—

$$U = Ra + m + e,$$

where m indicates the loss of mass due to liberation of helium in the successive stages of disintegration, and e the loss of energy represented by the various manifestations of energy. Since radium has a higher atomic volume than uranium we see that the progress of this reaction from left to right means an increase in volume and an evolution of energy, part of which is doubtless speedily transformed into heat. In fact, it is exactly the kind of reaction that would be inhibited by high pressure and temperature conditions.

That high pressure should be able to prevent the disintegration of uranium seems reasonable, if one accepts the electronic constitution of the atom. Judging from the extreme length of the half period of disintegration of uranium under surface conditions, the constituent electrons of an atom of uranium perform on the average a vast number of revolutions before the system arrives at the position of instability that permits the escape of a helium atom. In fact, the uranium atom is evidently stable during an enormous number of revolutions or vibrations. And if, when the electronic system arrives at last at an unstable configuration, a sufficiently powerful counterbalancing force can be applied from without, then the system will be helped past the danger point and be able to commence another long cycle of movements before the dangerous configuration is again assumed.

In view of the experiments of Humphreys and Mohler upon the displacement of the spectral lines, and the work of Richards on the compressibility of elements, amongst other facts, it is evidently possible to influence intra-atomic activity by means of forces applied from without. It seems probable, therefore, that pressure, if sufficiently great, could be transmitted to the interior of a uranium atom and supply the countervailing force required to help the atom past a position of instability. Once we realise this probability, we see a cogent reason why the interior of the earth should be free from radium and all other radio-active substances the formation of which from heavier elements demands an increase in volume, these heavy elements being at great depths only potentially radio-active.

From this point of view radio-activity is, as Dr. Schiller suggests, "an acquired habit of the substances that exhibit it," the habit being acquired when such an element passes by any means whatever from great depths below the earth's surface to regions of less pressure.

In a paper just issued in the Records of the Geological Survey of India (vol. xliii., part 1) I have given a preliminary account of these speculations concerning the mineralogical constitution of the earth's crust, and in a final paragraph have appended a brief reference to this question of the inhibition of the disintegration of uranium at great depths below the earth's surface.

L. L. Fermor.

Pianoforte Touch.

In connection with the discussion on this subject originated by Prof. Bryan's paper, I may mention that I have been making some measurements during the past winter with the view of obtaining some idea of the velocities and forces involved in the motion of the transmitting mechanism. By fitting an electric chronographic arrangement to an upright piano I have been able to measure the actual times taken in different stages of the movement with different degrees of loudness.

Among other results, I have found that the time during which the hammer is flying freely towards the string after losing contact with the propelling mechanism varies from about 0·04 sec. for *pp* to 0·001 sec. for *ff*. The distance of flight was about 1 cm., so the velocity ranged from 25 to 1000 cm. per sec. At the latter extreme, however, the force used in striking the key was greater than would be used in ordinary playing. On the other hand, when a weight was allowed to fall on the key from the smallest height to produce a note the time could be brought up to 0·07 sec., corresponding to a velocity of only 14 cm. per sec.

With regard to the much disputed point as to whether it is possible to vary the quality of the note independently of the loudness, this must, I think, still be regarded as an open question. Very positive affirmations are made by musicians on both sides. From a physical point of view the suggestion made by Mr. Tobias Matthay in his work on touch seems to be the only possible way to explain the effect, if it exists, viz. that the quality can be spoiled by vibrations of the hammer-shaft at the instant of striking the string. In accordance with this, Mr. Matthay holds that the tone is good when the final velocity is given to the key gradually, and is bad when the same velocity is imparted by a sudden blow. That vibrations of the shaft occur is, of course, undoubted, but whether they are sufficient to cause an appreciable effect is another matter. On the other side, recent German theorists, such as Breithaupt, Steinhausen, and Ritschl, deny the effect altogether. The last-named author holds that good touch consists in the power to produce fine gradations of intensity and in complete mastery of *legato* and the use of the pedal.

The essential question seems to be whether good and bad touch can be distinguished in a *single note* struck and allowed to die away, or in a succession of notes following each other at so long intervals as to be musically detached. As I understand Prof. Bryan, the improvement effected by his invention is chiefly apparent in a sequence of notes forming a melodic phrase. Further, I think that the exact dynamical effect of the contrivance on the motion of the key has not been made quite clear in the published account.

W. B. Morton.

The Queen's University of Belfast, July 2.

The Reflection of X-Rays by Crystals.

It is interesting to find that an X-ray bulb having a rhodium antikathode gives off a strong, sharply defined (and therefore very homogeneous) beam which is reflected from the (100) face of rock-salt at a glancing angle of 6·2°. Its mass absorption coefficient in aluminium is 3·2. A second weaker beam is reflected at an angle of 5·8°, and this appears to complete the rhodium X-spectrum. Assuming the correctness of my son's determination of the spacing of the atoms of rock-salt (in a paper read before the Royal Society on June 26), the wavelength of the stronger beam is $0·61 \times 10^{-8}$, and of the weaker $0·57 \times 10^{-8}$. It can be calculated that radiation of about this wave-length should be emitted by a rhodium antikathode; the argument is given in a paper recently read before the Royal Society (see abstract on p. 496 of this issue).

Platinum and rhodium give much stronger homogeneous reflected rays than iridium, tungsten, or nickel. The current produced in an ionisation chamber 15 cm. long, filled with SO_2, the slits being 3 mm. long and 0·8 mm. wide (Proc. Roy. Soc., lxxxviii., p. 428), is so great that the leaf of a Wilson electroscope races across the field of view at the rate of thirty or forty measurable divisions (three or four scale divisions) in a second. The setting must be exact, and the bulb should be very soft.

W. H. Bragg.

Rosehurst, Grosvenor Road, Leeds.

Wireless Antennæ.

Prof. Fleming, in a recent letter to a contemporary journal, has made a suggestion similar to that of Mr. A. Lander, in Nature of July 3 (p. 451), to the effect that the space wave in wireless telegraphy is supplemented by some effect which travels through the earth. Indeed, it would appear natural to expect that, in addition to the electric disturbance which must travel outwards in all directions over the conducting surface of the earth when the electrical potential at any point on this surface is disturbed, the passage of the electromagnetic waves through the air above the earth's surface should be accompanied by some form of electrical disturbance along the conducting earth's surface beneath them. This is, however, a subject that, so far as I am aware, has not yet been tackled by mathematical physicists, and I would point out that it is well worth their attention.

In connection with the matter, it may be of interest to mention that I find that my own body, without any wires or anything else, will serve as antenna for the reception of signals from the Admiralty. My receiving apparatus is on the ground floor of my house in Chester Square, and with my ordinary aërial disconnected I find I can get the Admiralty signals, faintly but quite audibly, simply by touching with my finger the terminal to which the aërial is usually connected. No doubt in this case my body does not act as an aërial in the ordinary way, but merely as a capacity into which the electrical disturbance arriving through the earth passes in and out through the receiving apparatus. The Admiralty station is, of course, comparatively near, and the signals are very powerful. This explains why it is only Admiralty signals that I am able to receive by this method.

I am unable to agree with Mr. Lander in his remarks as regards tuning, as I find that with my bedstead aërial it is just as easy to tune in and out such signals as I am able to receive as it is with my proper aërial, which is suspended on poles above the roof of the house. The Eiffel Tower signals are always difficult to tune out, for the reason, as I suppose, that they are of irregular wave-length, while I find it impossible to tune out the Admiralty by reason of its power and proximity. Norddeich and other unidentified signals that I obtain are, however, tuned in and out both with the bedstead aërial and with the other with equal facility.

For time signals very accurately tuned waves, such as are sent out by Norddeich, are perhaps not altogether an advantage, as badly tuned waves, such as are sent out by the Eiffel Tower, are much more easily picked up by all and sundry.

A. A. Campbell Swinton.

66 Victoria Street, Westminster, S.W., July 7.

A Mechanical Vacuum-Tube Regulator.

May I supplement Mr. Campbell Swinton's letter in Nature of June 26? The device of sliding a glass sleeve over the kathode for the purpose of varying the hardness of a discharge tube was also used and fully described by Wehnelt in 1903 (*Deutsch. Phys. Gesell. Verh.*, 5, 14, p. 259), some five years after Mr. Swinton.

The important part that the electrification on the walls plays in a discharge tube is not, I think, generally realised; and Mr. Swinton is not quite right in assuming that Mr. Whiddington's explanation is novel.

The electrification on the glass walls adjoining the kathode, and its concentrative effect on the beam of kathode rays, were remarked by Goldstein in 1901 (*ibid.* 3, 15, p. 192).

I remember some half-dozen years ago, Sir J. J. Thomson, in one of his lectures at Cambridge, gave a similar explanation of the formation of the fine pencil of kathode rays which can be seen crossing the bulb from the centre of the kathode in a soft X-ray tube. He attributed the effect entirely to the negative electrification of the glass round the kathode. The pencil of rays is as definite with a plane kathode as with a concave one.

But X-ray tube-makers have long been aware that, by withdrawing the kathode from the bulb into a side tube, the discharge can be hardened. In the earliest X-ray bulbs, the kathode was always mounted in the body of the bulb; but the advantages of a side tube had been realised by 1896, and the design has since been universally adopted.

Mr. Swinton was also responsible about 1897 for another adjustable form of X-ray bulb, in which, instead of a sliding sleeve, a movable kathode could be advanced in or out of a side tube. The bulb is at present in the Röntgen's Society's historical collection in the South Kensington Museum.

G. W. C. Kaye.

June 28.

In order to remove the possibility of any misunderstanding that may arise from Mr. A. Campbell Swinton's letter in Nature of June 26 (p. 425), may I state that the mechanical vacuum-tube regulator is *not* claimed by me as new in the paper referred to. If Mr. Campbell Swinton will read the actual paper he will find it clearly stated that the regulator was discovered by him.

Richard Whiddington.

St. John's College, Cambridge, July 7.

The Humphrey Owen Jones Memorial Fund.

The committee formed to carry out the generally expressed desire that some suitable memorial of the late Humphrey Owen Jones, F.R.S., should be established, has received subscriptions amounting to about 360*l*. It is proposed to devote the sum collected to the endowment of a teaching post in physical chemistry in the University of Cambridge.

The committee desires to close the subscription list at the end of this month, and requests further intending subscribers to send their contributions to the account of the H. O. Jones Memorial Fund, Messrs. Barclay and Co.'s Bank, Cambridge, before that date.

W. J. Pope
(Chairman of the Committee).

The Chemical Laboratory, Cambridge, July 7.

Smithsonian Physical Tables.

Attention was directed by Mr. C. T. Whitmell on p. 320 of Nature of May 29, to a "very awkward error" in the Smithsonian Physical Tables (1896). The institution is always glad to have attention directed to errors for correction in subsequent editions, but as this particular error does not appear in the first revised, second, third, fourth, and fifth editions, it seems rather unfortunate to have discredit thrown on the tables through an error long since corrected.

C. D. Walcott,
Secretary.

Smithsonian Institution, Washington, U.S.A.,
June 21.

MODERN VIEWS OF ELECTRO-THERAPEUTICS.

During the last few years our views upon the true meaning of the action of electricity upon living subjects have been growing much clearer. We begin to see the principles upon which our practice should be based, and already, as a consequence of this, our methods are changing and our results are growing more valuable.

There are two factors which have brought this about. One is the recognition of the importance of the theory of ions in all matters which concern the movement of electric currents in living tissues, and is due to the genius of Leduc, and the other is the recognition of the thermal action of high-frequency currents, an action which remained unappreciated, even if not unknown, until it was insisted on and emphasised by Nagelschmidt. It is upon these two basic facts, the chemical or ionic effects and the thermal effects of electric currents, that the electro-therapeutics of the future will be established.

First, as to the chemical aspect of the medical applications of electric currents. To begin with, all movements of current in the body, whether the currents are direct, interrupted or alternating, are ionic movements pure and simple, and their effects are due to the chemical displacements produced. We may not speak of effects which are additional to or independent of the ionic movement, for such effects do not exist. The current in the body is the double ionic movement only. The treatment by electric currents is a chemical treatment, and its chemical actions must explain the results obtained.

The stimulation of nerve and muscle is a chemical stimulation by displacement of ions. Nernst, in fact, has expressed the formula for nerve excitation in terms of ions. The sensation felt in the skin during the passage of a current is a chemical effect, and by altering the composition of the saline solution with which the electrodes are moistened, its character can be altered so that the sensory effects become more noticeable either at the negative or at the positive electrode. With sodium carbonate it is the negative electrode (ions of CO_3) which gives the greatest sensation. With sodium chloride it is the positive electrode (sodium ions), and so on in great variety.

Thus a practical lesson may at once be drawn from a knowledge of ionic effects, namely, that a solution of sodium carbonate should not be used for moistening the electrodes in electro-diagnosis, because in that procedure a small negative electrode is used with high concentration of current, and in these circumstances the presence of a carbonate in the liquid causes unnecessary pain to the patient. Again, in using chlorine ions for the softening of scar-tissue it saves the patient some discomfort and facilitates the toleration of massive currents to use the chloride of ammonium at the anode in preference to that of sodium, because the ammonium ion affects the sensory nerves of the skin in a less degree than the ion of sodium.

There is another direction in which the application of the principles of ionic movement has increased the therapeutic powers of electrical applications, and that is in the direction of treatment by larger currents. If we look in the text-books of electro-therapeutics we see continually that currents of 5 or 10 milliamperes are prescribed. Formerly that was as much as could be given without causing discomfort or producing superficial burns. The metal-plate electrodes and the small buttons or discs covered with a thin layer of chamois leather and set in handles and applied to the affected region did not permit the use of large currents; Leduc has told us why this is the case. With such electrodes the ions of hydrogen and hydroxyl which are formed at the metallic surfaces can quickly reach the skin surface. They are strongly caustic and tend to produce pain and burns, and this can be obviated by the use of electrodes composed of thick, folded cloths over which is laid a metal electrode faced with two or three layers of thick felt. The whole is moistened with appropriate saline solutions and bandaged to the patient, who thus can tolerate applications of 50 milliamperes or more, and that for times of fifteen or twenty minutes or longer without any burning or blistering of the skin.

It is not surprising that this change of method brings results which are superior to those of the past. Indeed, if the theory of ions in medical electricity had done nothing else of value, it would deserve all praise for having taught us how to use larger currents. Take, for instance, the treatment of paralysed muscles. A distinguished French writer has recently told us that he has gradually increased the duration of his electrical applications in such conditions to periods of one hour twice daily, and uses rhythmic currents which are not less than 25 milliamperes, and that in the infantile paralysis of children the little patient is so slightly inconvenienced by these applications as to play and even to sleep while they are proceeding; also that the results of such intensive treatment are entirely good, and produce not the least sign of fatigue or exhaustion.

The ionic theory of electrical treatment which has shown us how to use large currents has also shown the necessity for them. If the results to be gained are produced by the chemical interchange set up in a tissue, it is manifest that to obtain them one must use a strength of current which is capable of producing a distinct effect; and for the same reason the time of an application must be lengthened. The chemical changes caused by a current of 50 milliamperes for twenty minutes are ten times greater than those given by 10 milliamperes for ten minutes, and are therefore ten times more likely to produce an appreciable effect. The results of adopting this view and of increasing the quantity of current employed may make all the difference between success and failure. It is thus that the treatment of neuralgias can be made effective, and the same occurs in the treatment of many affections of the joint structures.

In the ionic theory of electrical treatment we have to consider two factors—the chemical interchanges set up within the tissues and the introduction of ions from without. The second of these considerations has added notably to the scope of electrical treatment. In the treatment of superficial morbid states there can be no doubt of the actual penetration of the external ions into the part treated; and the use of the zinc ion introduced at the positive pole from material moistened with a solution of a zinc salt has led to the successful treatment by electrical means of a whole series of superficial ulcerative conditions of the skin and the various orifices of the body.

In the treatment of affections of the deeper tissues the method of the introduction of ions from pads moistened with appropriate solutions has also achieved many successes, notably in conditions of so-called neuralgia, states which are almost always due to neuritis or perineuritis—for example, in many severe neuralgias of the trigeminal nerve. Quinine and salicylic acid, the latter especially, are useful in these conditions when introduced by the electric current.

In chronic gouty conditions the introduction of the salicylic ion is also of great value. Iodine ions and lithium ions to a lesser extent also seem to be useful in gouty conditions. The chlorine ion, recommended by Leduc for its softening action upon scar-tissue, has proved itself valuable.

Leaving the chemical effects of electrical currents, let us turn to the consideration of the thermal effects. The use of electricity for thermal effects requires currents of large magnitude, and therefore requires that the ionic effects shall be reduced to a minimum. The currents of high frequency answer these requirements. With them the duration of each wave of current is so brief that the ionic movement set up is imperceptible; the displacement which the ions undergo in the very small fraction of a second for which each wave continues is minute and does not strain the elasticity of the protoplasm, if one may make use of such a phrase. On this account the currents employed may reach an ampere or more, and the usual ionic effects of currents, such as pain and muscular contraction, are absent. The thermal effects become manifest in proportion to the magnitude of the currents employed. The practical recognition of the thermal action of high-frequency currents remained long unnoticed, in spite of the great popularity enjoyed by high-frequency treatment some time ago. Somerville may be said to have awakened medical practitioners to its possible importance by his paper in 1906 on the effect of high-frequency currents in raising the surface-temperature of the body.

When we look back upon the cases which have been reported as cured by currents of high frequency we may now recognise that a large part of them can be justly attributed to thermal actions and the vasomotor effects secondary to these. The circulatory effects, the relief of various states of spasm and congestion, and of painful affections of the joints, of neuritis and neuralgia come into this category. An improvement in the lymph circulation due to the warmth would account for the results obtained with high-frequency currents in certain local infections and inflammations.

In another section of high-frequency treatment, namely that of the use of the effluve or of showers of sparks in cutaneous affections, we also have to deal with thermal effects, intense but minutely localised, though it is possible that in these cases there may be another factor concerned, namely the influence of the ozone, and of the nitric acid vapours which are associated with luminous electrical discharges.

We now perceive that in high-frequency applications we have an agent for the direct warming of the tissues traversed by the current, and that the future development of high-frequency treatment will be based upon these thermal effects. The progress which has been made by Nagelschmidt and others with the large currents obtained from the modern type of high-frequency apparatus, which uses sustained oscillations, and is known under the name of diathermy, serves to emphasise this aspect of high-frequency currents. Duddell's singing arc in a modified form is used for the production of the oscillations in the diathermy apparatus.

Again, in electro-diagnosis we are on the threshold of another change. The long and patient work of many investigators upon the use of condenser discharges has begun to bear fruit, and it is clear that from the condenser we gain greater information than the induction coil and the galvanic current can give us as to the degree of abnormality in muscle in cases of paralysis, while the process of testing with condenser discharges is simpler in application and far less painful to the patient. Whereas hitherto neurologists have been content to divide muscles into two categories, those with "normal" reactions and those with a reaction of degeneration, the condenser method now permits the recognition of a considerable number of intermediate degrees. The method is based upon the observation of the minimum capacity needed to provoke the muscular contraction. As a muscle deviates from the normal standard it comes to need waves of longer and longer duration in proportion to its degree of damage, and these waves are best obtained by using a series of condensers of progressively increased capacity, charged from a constant source and discharged through the patient. Many of the muscles formerly described as normal because they had not lost the power of responding to induction-coil currents can now be seen to present different degrees of deviation from the normal, and those classed together as showing a reaction of degeneration can also be divided into distinct groups. Working with 100 volts to charge the condensers, one can use a series of ten or twelve capacities, ranging from 0·01 to 2·0 microfarads, and can find muscles showing their initial contraction at almost every step in the scale.

The work of Boudet de Pâris, Hoorweg, Zanietowski, Weiss, Doumer, Cluzet, and of many other patient students of condenser discharges must be gratefully acknowledged in this connection. They have gradually brought their methods through the laboratory stages and rendered them suitable for everyday clinical work so that electro-diagnosis in the immediate future is sure to develop in the direction of condenser discharges, and the old method with induction coil and battery current may be regarded as obsolete.

With these evidences of progress the electro-therapeutist of to-day can feel more hopeful. He is no longer tied to the old routine methods, and sees before him the commencement of a therapeutic method based upon the laws of chemistry and physics.

H. L. J.

INTERNATIONAL FISHERY INVESTIGATIONS.[1]

THE series of reports now under review on the work of the International Council for the Study of the Sea furnishes evidence of continued activity in many branches of the work. One of the most interesting new features is described in the hydrographical bulletin, which contains an account of a series of observations on tempera-

[1] Conseil Permanent International pour l'Exploration de la Mer. Bulletin Hydrographique pour l'Année Juillet 1910–Juin 1911.—Bulletin Planktonique pour les Années 1908–11.—Publications de Circonstance, No. 62.—Rapports et Procès-Verbaux des Réunions, vol. xiv., 1910–11.—Bulletin Statistique des Pêches maritimes des Pays du nord de l'Europe, vol. vi., pour l'année 1909.—Investigations on the Plaice. General Report by Dr. F. Heincke. 1. Plaice Fishery and Protective Measures (Preliminary brief summary of the most important points of the Report).—Procès-Verbaux des Réunions du Conseil et des Sections, Copenhague, Septembre 1912.

tures, salinities, and direct-current measurements made from ten vessels which were anchored for fourteen days (June 1 to 14, 1911) in a series of positions in the North Sea, selected with the view of studying the principal currents. A repetition of observations of this character from time to time as opportunity offers cannot fail to give information of the utmost value.

The plankton bulletin is composed entirely of tables, recording the species found in samples taken during the years 1908 to 1911; and from the number of records given it is evident that this side of the investigations has recently received far less attention than was formerly given to it. This is probably due to two causes. In the first place, the amount of time which is necessarily consumed in examining and recording a large series of plankton samples is very great indeed, and in the second place a doubt exists in many minds as to whether any very useful results will accrue from an indefinite continuation of work on the plan which up to the present has been followed. What seems to be required at the moment in plankton work is more freedom and liberty to the individual worker to devise and test new methods of quantitative investigation, which may eventually enable a trustworthy estimate of the annual and seasonal fluctuations to be arrived at by some means less open to criticism on the ground of trustworthiness and at the same time not so prohibitively laborious as the enumeration method of the Kiel school of workers.

For investigations on the minutest plankton forms—the nannoplankton of Lohmann—the enumeration method will doubtless have to be retained, and the plan for the preservation of samples for this purpose, described by Gran in *Publications de Circonstance*, No. 62, marks a useful step in advance. The method consists in adding to samples of sea-water, taken with a water-bottle from known depths, a small quantity of Flemming's strong solution. The samples may be kept in this way for many months, and, without any attempt at washing out the Flemming's solution, portions of the sample can be centrifuged, the minute plankton forms which are thus separated out being identified and counted under the microscope.

Vol. xiv. of the *Rapports et Procès-Verbaux* contains a number of papers of great interest dealing with investigations of food fishes. Dr. P. P. C. Hoek reports on the Clupeoids (other than the herring), Prof. D'Arcy Thompson on the later stages of the Gadoids, Dr. Masterman on the later stages of the Pleuronectidæ, and Dr. Johansen on the eggs, larvæ, and later stages of Pleuronectidæ from the Baltic. Dr. Ehrenbaum contributes a summary of a more extensive report which he is preparing on the mackerel, which not only brings together previous work, but also gives much new information on the habits and life-history of this important fish, at the same time making it clear that much further investigation is necessary. He points out amongst other things that little or nothing is known of the small adult stages of this common fish, which, in spite of extensive fishing with nets that certainly ought to capture them, have rarely been taken, and then only in very small numbers.

Finally, the volume contains a useful report by Dr. Redeke on the present condition of our knowledge of the races of marketable fishes, in which the importance of further researches into this subject is made clear.

The International Council publishes as a separate volume what is described as a "preliminary brief summary" of the first part of Prof. Heincke's general report upon investigations on the plaice. This first part is entitled "Plaice Fishery and Protective Measures," and from the *procès-verbaux* of the meeting held in Copenhagen in September, 1912, we learn that the summary was then laid before the council and referred by it to a special committee. The latter committee was not, however, prepared to adopt immediately the recommendations made by Prof. Heincke, and the matter was further deferred.

These recommendations, put forward in a somewhat tentative way, comprise the imposition upon an international basis of a size-limit for plaice, below which the fish may be neither landed nor sold. It would appear that the great destruction of immature plaice which now takes place could only be effectively stopped if this size-limit were fixed at 25 to 26 cm. Such a high limit would, however, mean the immediate ruin of many inshore fisheries carried on by sailing trawlers. As most of these vessels on the continental side land their plaice *alive*, Prof. Heincke suggests that a lower size-limit of 22 or 23 cm. might be allowed for fish which are so landed. It must be pointed out, however, that this would not meet the difficulty in English ports such as Lowestoft and Ramsgate, where a size-limit of 25 or 26 cm. would probably mean the ruin of the trawling industry. Prof. Heincke emphasises the fact that the introduction of a size-limit would, in the first instance, be in the nature of an experiment, and that it is not possible to say beforehand with any certainty exactly what effect it would have on the fishery. The problem is, in fact, a much more complex one than it at first sight appears to be. A consideration of the present preliminary report rather suggests that the International Council has not yet had that problem adequately laid before it in all its numerous aspects and in a sufficiently comprehensive way. The council would scarcely at present be justified in proposing restrictions which would certainly, in the first instance, injure very seriously the livelihood of many owners and fishermen who are dependent upon the smaller boats.

AMERICAN UNIVERSITIES AND COLLEGES.

THE seventh annual report of the president and treasurer of the Carnegie Foundation for the Advancement of Teaching bears ample witness to the stimulating powers which come from the wise administration of an income of nearly 130,000*l.* a year in furtherance of a definite end. Here it is the provision or supplementing of pensions for the teachers of institutions of university rank. The trustees' report is as interesting and informing as ever. The glimpses one gets into the heart of higher education in the States offer some comfort to the Englishman who is inclined to lament what he may call the mediævalism of our ancient universities. After all, there is in the States the Brown University, the governing body of which must contain a majority of Baptists; the same denomination also controls the destinies of the great University of Chicago, the president and two thirds of the trustees of which must conform. Neither of these institutions can share in the benefits of the Carnegie fund because of their religious restrictions, but, as a result of the existence of that fund, Brown is saving 1,000,000 dollars and Chicago 2,000,000 dollars, each for its own pension purposes.

The report contains a survey of State and municipal schemes for teachers' pensions, which is particularly interesting to us at the present moment. In many, if not in most, States, the "flat-rate" system has been adopted. A pension of 400 dollars after thirty to forty years' service is the normal arrangement. New York is more liberal. It provides pensions equal to one-half the retiring salary after thirty years' service. No pension is to be less than 600 dollars, and none more than 1500 dollars. The upper and lower limits in Boston are 600 and 312 dollars respectively, the basis of calculation within those limits being one-third the annual salary. Philadelphia gives from 400 to 800 dollars on the half-salary basis. Many cities and States have, however, not yet made provision of this kind for the staffs of their public schools, but the movement is progressing, thanks to the example of the Carnegie foundation.

The influence of the foundation has been particularly beneficent in the vexed question of college or university entrance requirements. "The border-line between secondary school and college resembles nothing so much as a species of border warfare," but colleges are steadily changing their standards of admission by requiring the completion of a satisfactory four-year course instead of a certificate of having completed so many "units" of study—a system not unlike that which encouraged elementary-school teachers to pile up as many South Kensington science certificates as possible, in order to increase their chances of promotion.

Nothing illustrates more effectively the good which this annual survey of higher education in the States is exerting than the chapters on "Advertising as a Factor in Education," "Education and Politics," and "Sham Universities." Readers of American journals know something of the first, but probably they have not realised the full extent of the evil. The examples pilloried in this chapter come as a violent shock to our sense of academic decorum. The trustees think the use of pictorial and coloured circulars by universities and colleges is distinctly limited, and they see objections to the practice of printing academic biographies of professors in the college prospectus, but Reed College at Portland, Oregon, exceeds all bounds by including in these biographies "editorships of college annuals, class votes on popularity, degrees that are expected, academic biographies of professors' wives, the number of their children, and finally portraits" of the staff. Even this gross breach of academic decency is beaten by McMinnville College, which advertises a "hand-picked" faculty producing "a product second to none in America." But Muskingham College, Ohio, bears the palm in this type of vulgarity. Its alumni include "the most beloved Bible teacher in America." It represents itself as at the geographical centre of the Church (Presbyterian), and prints "a rude cartoon of an old shoe filled and overflowing with riotous students, while a figure in academic costume chases others away with a bundle of sticks." Below the cartoon are verses of which this is a specimen :—

There is a college president, like the woman in the shoe,
Who has so many children that he doesn't know what to do.
He tries to treat them fairly, and give them each some room,
But the college grows so grandly, like a town site on the boom,
That unless her friends soon rally and provide another shoe,
He must say to all new-comers: "Get out of here! Skiddoo!"

Abuses of this kind obviously do much to discredit all that is really good in the higher education of the States.

The Educational Bureau at Washington is also waking up to some well-known evils. The Commissioner has been looking into the question of universities and colleges which confer degrees. He finds only fifty-nine the degrees of which are wholly satisfactory, and 161 where they are approximately so, but the report under review tells us that these are less than a fourth of the institutions in the country which call themselves universities and colleges, all of which grant degrees.

The trustees of this foundation deserve the thanks of the American community for the courageous way in which they are discharging their great trust. J. A. GREEN.

NOTES.

As announced already, the dedication of a window in memory of Lord Kelvin will take place in Westminster Abbey on Tuesday, July 15, at 3 p.m. The window, which is the result of action taken by engineers in the British Dominions and the United States, has been placed in the north aisle of the nave, in close proximity to the one erected in 1909 by civil engineers to the memory of Sir Benjamin Baker; and it has been designed and made by the same artist, Mr. J. N. Comper. A special service, with music, is being arranged by the Abbey authorities, and Mr. R. Elliott-Cooper, president of the Institution of Civil Engineers, will make the formal presentation of the window on behalf of the donors. Members of the American engineering societies and of the Canadian Society of Civil Engineers who may be in London at the time are invited to attend the dedication ceremony, whether they subscribed to the cost of the window or not, and they may obtain cards of admission by writing before Monday, July 14, to the secretary of the Institution of Civil Engineers, 12 Dartmouth Street, Westminster, S.W.

The allocation by the Mansion House Committee of the Scott Fund shows every evidence of a most careful consideration of all the interests involved. The allocation falls under the three main headings of provision for the relatives of those lost (or, in one instance, incapacitated), for the publication of the scientific results, and for memorials. The provision for the relatives includes 8500*l.* each for Lady Scott and Mrs. Wilson, 6000*l.* for Mrs. Scott and her daughters, 4500*l.* for Mrs. Bowers and her daughters, and 3500*l.* in trust for the child Peter Scott, with smaller sums for Evans's family and to meet need in other two cases. The arrangements for publication of the scientific results have failed to commend themselves to one member of the committee, but they can scarcely, on general grounds, be regarded as ungenerous. One of the honorary secretaries of the Royal Geographical Society, Capt. H. G. Lyons, F.R.S., appropriately undertakes their editorship, and representatives of that body and of the Royal Society, with Surgeon Atkinson, will control the work. A total sum of 17,500*l.* provides, besides the cost of publication, for the services of three biologists, three geologists, two physicists, other specialists, and a draughtsman, and the figure of 800*l.*—an ample but not excessive provision—is earmarked for the production of charts and maps. As regards the arrangements for memorials, a tablet in St. Paul's Cathedral is fitting; a group of statuary was doubtless inevitable; it is proposed that it should stand in Hyde Park facing the Royal Geographical Society's house. A contribution to a memorial to Oates, which is being raised by his regiment, is admirable as a special expression of regard for the memory of one whose relatives need no assistance from the fund. The published results of the expedition will not form its only scientific memorial; the establishment of a trust fund of some 10,000*l.* for the endowment of future polar research will perhaps in the long run preserve most honourably the memory of a great scientific expedition, and would, in the belief of the committee, have commended itself greatly to its leader.

The council of the Royal Society of Edinburgh has awarded the Gunning Victoria Jubilee Prize for the quadrennial period 1908–12 to Prof. J. Norman Collie, F.R.S., for his distinguished contributions to chemistry—organic and inorganic—during twenty-seven years, including his work upon neon and other rare gases. Prof. Collie's early papers were contributed to the Transactions of the society. The council has also awarded the Makdougall-Brisbane prize for the biennial period 1910–12 to Dr. John Brownlee, for his contributions to the theory of Mendelian distributions and cognate subjects, published in the Proceedings of the society within and prior to the prescribed period.

At a meeting of the electing trustees of the British Museum, held on July 2, Sir Archibald Geikie, K.C.B., P.R.S., was elected a trustee of the British Museum in succession to the late Lord Avebury. Sir A. Geikie was already an *ex-officio* trustee, in virtue of his position as president of the Royal Society; but his tenure of that office comes to an end in November next, and his services would have been lost to the British Museum but for his present election as a trustee for life.

An association of amateurs interested in wireless telegraphy and telephony has been formed, under the title of "The London Wireless Club." A meeting will be held in September next, for the purpose of electing a committee. The honorary secretary *pro tem.* is Mr. R. H. Klein, 18 Crediton Road, West Hampstead, N.W.

Sir Robert Lucas-Tooth has given a donation of 1000*l.* to the fund that Capt. J. K. Davis is raising in this country for Dr. Mawson's Australasian Antarctic Expedition. We learn from *The Times* that Capt. Davis leaves England on July 18 for Australia. On his arrival there the *Aurora* will be refitted and will proceed to Commonwealth Bay to bring back Dr. Mawson and his six companions at present in the Antarctic.

The discussion by a Standing Committee of the House of Commons of the Bill to prohibit experiments on dogs was continued on July 2. As was pointed out in our issue of last week, the Bill proposes to enact that it shall be unlawful to perform any experiments of a nature causing or likely to cause pain or disease to any dog for any purpose whatsoever, either with or without anæsthetics. At the Committee meeting on July 2 an amendment was carried that the Bill should apply only to inoculation experiments. The Bill is again under consideration by the Committee as we go to press.

The annual conference of the Museums Association, which is to be held at Hull this year, will open on Monday next, July 14, under the presidency of Mr. E. Howarth, curator of the Sheffield Public Museums and Art Gallery. Many interesting subjects are to be discussed, among them being the possibility of showing our museums and art galleries to the blind, arising out of experiments made by Mr. J. A. Charlton Deas, at Sunderland Museum and Art Gallery. The peripatetic guides at the British Museum (both Bloomsbury and South Kensington) will attend to give their experiences in the personal conduction of visitors around these institutions, and Prof. Rathgen, of Berlin, is to discourse on the decay and preservation of antiquities. The local secretary for the meeting is Mr. Thos. Sheppard, of the Hull Museum. The secretary of the association is Mr. E. E. Lowe, curator of the Leicester Museum and Art Gallery.

The Institut de Paléontologie Humaine, founded by Albert I., Prince of Monaco, has issued a report of the investigations conducted in 1912 by MM. Breuil and Obermaier. The most interesting discoveries are two fine examples of the decorated staves called by French archæologists *batons de commandement,* from Spanish caves; a rough delineation of an animal, perhaps a horse, and a male human figure from the grotto of San Garcia in Burgos; and a remarkable series of figures from the Sierra Morena and Velez Blanco caves, illustrating the evolution of design in a female idol of the early Neolithic age. The explorers record their obligations to an English antiquarian, Col. Willoughby Verner, for his researches in the Peleta cave at Benaojan, Malaga, and describe the visit of M. Breuil, under the guidance of Prof. Sollas, to the well-known Bacon Hole, near Swansea, which corroborated the identification of the Palæolithic drawings on its walls.

American archæologists, having settled the main problems which the continent presents, are now devoting themselves to regional, intensive exploration. Mr. Clark Wissler has recently issued in Bulletin 9 of the Geological Survey of New Jersey a preliminary report on archæology. The surface sites so far reported are rare except in restricted areas, which correspond with the distribution of the Lenápé Indians during the early settlement period, and it thus appears that all such remains belong to the historic Indians and their immediate ancestors. No positive traces of a pre-Indian culture have been discovered. Long lists and descriptions of the remains are given, classified as camp and village sites, shell-heaps, cemeteries, rock shelters, quarries, caches, and trails, the camp and village sites being most abundant. Stone implements are abundant, but as regards palæoliths, though the existence of such seems to have been demonstrated by Volk in the Delaware Valley, some archæologists are not satisfied that they are human in origin.

We have received the Livingstone College Year Book for 1913, which gives particulars of the work done there, extracts from the letters of old students, &c. The college is established for the training of missionaries in the elements of medicine and hygiene. An appeal is made for 10,000*l.* for paying off a mortgage on the property and establishing a small endowment fund.

Parts 1 and 2 of *Mikrokosmos* (7 Jahrg., 1913–14) contain several well-illustrated articles of interest to microscopists, *e.g.* a simple illuminating apparatus, a new form of mechanical stage, preparation of material, development of protozoa, &c. Herr Günther and Dr. Stehli contribute lists of common plants in suitable condition during April and May for the demonstration of special structures, &c., which are indicated, with their habitat.

A ninth research report, by Dr. Houston, director of water examination, has been issued by the Metropolitan Water Board. It deals with a search for the typhoid bacillus in *raw* river water and crude sewage, and is a continuation of the author's former investigations on the same question (see second, fifth, and seventh research reports). Twenty-eight samples of crude sewage were examined, mostly from Barking or Hendon, also from Dublin, Belfast, Edinburgh, and Aberdeen, but in no case was the typhoid bacillus detected. Dr. Houston concludes that the home of the typhoid bacillus is not so much in impure water, or even in the crude sewage from a large community, as in the "factories" of disease, as exemplified by the "carrier" case.

Among the cases referred to in a recent batch of Opinions (52 to 56) issued by the International Commission on Zoological Nomenclature at Washington is that of the rodent genus Ondatra, frequently considered as applicable to the South American coypu, commonly known as Myocastor or Myopotamus. In the opinion of the majority of the committee this usage is, however, considered erroneous, the name really belonging to the musk-rat, originally described as *Mus zibethicus.*

To the May number of *The National Geographic Magazine* Mr. E. C. le Munyon communicates a richly illustrated account of his experiences in conveying a motor-car for the use of the Tasha-Lama from Tientsin across the Gobi to Urga, in northern Mongolia. One of the plates shows a vast flock of sheep, probably of the Hunia breed, on the march to Pekin, whence a large quantity of the wool—which is chiefly employed in carpet-making—is exported to America. The author also encountered enormous herds of wild horses and "antelopes," the latter being doubtless the Mongolian gazelle or one of the allied species. It may be added that the motor reached its destination in excellent working order.

A paper by Prof. A. Keith on the teeth of prehistoric man is published in the Odontological Series of the Proceedings of the Royal Society of Medicine, vol vi. After noticing certain variations from the modern type characteristic of many prehistoric molars, the author proposes the term "taurodontism" for the modification in which the crown tends to become excessively wide in proportion to the root, while "cynodontism" is suggested for the opposite condition. Taurodontism is stated to be excessively developed in Neanderthal man, whose teeth, although primitive or simian in some features, are regarded as highly specialised in others; the dentition of the Galley Hill man is, however, regarded as still more simian in character.

In an article in the June number of *The Zoologist* on his experiences of hunting the hump-backed whale from one of the two whaling stations at Durban, Mr. T. B. Goodall directs attention to what he regards as a misinterpretation of the relationship of the plates of whalebone to the plate in the whalebone-whales. It is generally stated in text-books that these plates are outgrowths of ridges on the palate, comparable to the rugæ on that of cattle. Mr. Goodall states, however, that the plates arise on the outer sides of two median raised ridges of mucous membrane, which can apparently be raised or depressed. These ridges, or folds, he thinks, probably represent the gums, although it is also suggested that they may correspond to the upper lips. In consequence of this, the plates of whalebone, according to the author, appear to be quite distinct from the palate, and to be outside the gums and inside the cheeks, or, on the hypothesis that the longitudinal folds are the upper lips, the plates "are really modified hairs of a veritable moustache on an inverted upper lip." It is added that the weight of one of these whales is computed at a ton to the foot, so that a 60-ft. humpback would weigh 60 tons. A newly-born humpback is stated to have measured 16 ft. in length, and to have weighed a couple of tons.

DR. GERTRUD TOBLER has given an elaborate account of the genus Synchytrium in her recently published work, "Die Synchytrien: Studien zu einer Monographie der Gattung" (Jena: G. Fischer, 5 marks). The group (Chytridiales) to which this genus belongs includes the most interesting of the lower fungi, and Frau Tobler's detailed studies include its morphology, cytology, development, influence on the host plants, and geographical distribution, together with systematic descriptions of the fifty-one recognised species and a list of their host plants. The work also includes a historical summary and a full list of literature, and there are four plates.

THE greater portion of tome 25, No. 4, of the *Bulletin de la Société Impériale des Naturalistes de Moscou* is occupied by two papers on the mechanical tissues of plants. In the first paper W. Rasdorsky gives a useful historical summary of previous work on this subject between 1873 and 1910, and of the present state of knowledge concerning the mechanics of vegetable tissues in both flowering and flowerless plants. In the second paper this author and I. A. Kalinnikow give a long account of their own researches with apparatus devised by themselves for testing the strength of fibres and other tissues. The results are set forth in numerous tables and diagrams, relating chiefly to experiments with the stalks and blades of palm leaves and with various kinds of iron and steel. Plant fibres were found to have about the same tensile strength as wrought-iron, and in some cases approached that of steel, while they greatly exceed iron and steel in elasticity, though falling far short of these metals in ductility.

A COPY has reached us of the first report of the Forest Branch of the Department of Lands, British Columbia. This branch was created in February, 1912, and the result of the first year's work reflects great credit upon the Chief Forester, Mr. H. R. Macmillan, and his assistants. British Columbia contains one of the few great bodies of commercial timber left in the world which are not yet materially reduced by destructive lumbering, and, with the possible exceptions of Siberia, Brazil, and the north-western United States, the timber wealth of British Columbia is unparalleled in any other country, since it contains not less than one hundred million acres of forest land. At the present rate of cutting, making no allowance for annual growth, it would take nearly 250 years to use up merely the mature timber now standing; the annual growth of the forests is even now, though they are not yet adequately protected against fire and waste, not less than five times the present annual cutting. Great stress is laid on the need for a prudent policy of forest utilisation and protection, including the formation of forest reserves in such areas as are unsuited for agricultural use. The report is illustrated by thirty-three very fine photographs, which, besides their immediate purpose, serve to convey an admirable impression of the forest vegetation of the province in its ecological aspects.

THE useful ice reports contained in the meteorological chart issued by the *Deutsche Seewarte* for the North Atlantic Ocean for July show that early in June a great quantity of drift ice was still met with, especially north of latitude 45° N., where the Newfoundland Bank and the district to the east of it, as far as longitude 41° W., were thickly beset with bergs. South of latitude 45° N. the difficulties were not so great; drift ice had much increased since the previous month, but a further advance of the ice southwards was not observed. Two bergs were sighted on June 7, so far south as 43·1° N., 42·8° W., and the possibility of a further advance would naturally have to be taken into account.

THE valuable publication entitled *Deutsche überseeische meteorologische Beobachtungen*, vol. xxi., containing data for 1911, is issued by the Seewarte, as in previous years, with the assistance of the Imperial Colonial Office, the results being prepared with much care by Dr. P. Heidke. The volume is considerably enlarged compared with that of the previous year (NATURE, August 22, 1912) by the addition of observations at definite hours at some stations in the Cameroon district and in German South-West Africa. The discussion and publication of observations for the Protectorate of German New Guinea, and for several islands in the Pacific Ocean, are also contemplated. The volume forms a most important contribution to our knowledge of the climatology of many remote regions.

WE have received from Dr. Louis Bell, whose book on illumination is so well known, a copy of a note he communicated to *The Electrical World* for May 24 on silvered mirrors and their preservation. It appears that the method of covering a silver mirror with a thin layer of collodion, first suggested by M. Perot in the *Comptes rendus* for November, 1909, may be carried out by applying the ordinary lacquer supplied commercially for protecting silverware. Dr. Bell uses clear "Lastina" lacquer diluted with two parts of the thinner provided with it, and floods the mirror with the solution. On drying, the mirror has lost about 4 per cent. of its reflecting power. A still more dilute solution was used for the 2-ft. parabolic speculum reflector of Harvard Observatory. The definition was unimpaired, and after three months of regular service the mirror had only diminished slightly in brilliancy.

THE part of the Proceedings of the Physical Society of London dated June 15 has reached us. We note that the Proceedings are now issued at intervals of two months. The present part consists of more than ninety pages, and contains twelve papers communicated to the society between March 7 and May 8. Each paper is accompanied by an abstract and by a short account of the discussion which followed the reading of it. Mr. T.

Smith's contribution to the discussion of Mr. W. R. Bower's paper on a graphical method of optical imagery covers five pages, and contains all the essentials of Gauss's analytical method and an example of its use. A paper by Dr. W. H. Eccles deals with the important question of the cause of the behaviour of the light electrical contacts used as detectors in wireless telegraphy. Dr. Eccles shows that nothing further is required to explain the behaviour of the different types of contacts than the laws of generation of heat in conductors by electric currents and the laws of thermo-electricity.

In a short note in the *Gazzetta Chimica Italiana* (vol. xliii., i., 197) Mr. A. Pieroni describes a new method of preparing colloidal solutions, which consists in dissolving, for instance, silver nitrate or copper sulphate in pyridine containing pyrogallol or tannic acid, and subsequently diluting with water. Under these conditions, colloidal solutions of copper or silver are obtained which are much more concentrated than colloidal solutions of the same metals in water only; in the case of silver, for instance, relatively stable solutions, containing 0·05 to 0·064 per cent. of the metal, can be obtained.

We have received from the United Tanners' Federation of Great Britain and Ireland a copy of "The Tanners' Yearbook" (3*s*., post free), which, besides containing a report of the work of the central committee of the Tanners' Federation during 1912, contains statistics of leather and of materials employed in the leather industry, and a number of articles on matters of technical interest. Some of these are of scientific importance; for instance, the article on the mimosa-bark industry of South Africa, by Dr. J. Gordon Parker, and that on the new synthetic tannin, "Neradol D," manufactured by the Badische Co., Ltd.

The Journal of the Marine Biological Association (vol ix., No. 4) contains an important paper by the late Mr. G. H. Drew on the precipitation of calcium carbonate by marine bacteria. Evidence is brought forward to show that the chalky mud flats forming the Great Bahama Bank and those which are found in the neighbourhood of the Florida Keys are now being precipitated by the action of a new bacterium, to which, owing to its power of precipitating calcium carbonate from dilute solutions of calcium salts, the name *Bacterium calcis* is given. The isolation and characteristics of the bacterium are described and the hypothesis put forward that in the formation of the various chalk and oolite strata the *Bacterium calcis* or similar bacteria have played an important part, as well as the Foraminifera and larger organisms; if such a view be correct these strata must have been deposited in comparatively shallow water, the temperature of which approximated to that of the modern tropical seas.

The second Gustave Canet lecture, delivered by Dr. Dugald Clerk, before the Junior Institution of Engineers, on June 30, dealt with the present state of our knowledge of the working fluid of internal-combustion engines. The combined work of English and Continental physicists and engineers has thrown much light upon the physical and chemical behaviour of flame, and it is now possible to give an approximately accurate account of the leading phenomena of combustion, explosion, and expansion, so far as concerns the engineer. Dr. Clerk gave a useful summary, together with the principal results, of modern experiments on temperatures in the gas-engine cylinder, on the internal energy of gas-engine mixtures, on explosions in closed vessels, on turbulence, and on radiation. With the view of testing the accuracy of the data thus accumulated, there are several trials on gas-engines included, together with the reduction of the results. The information thus given presents a very full statement of our knowledge, as might be expected from Dr. Clerk's personal connection with the British Association committee formed in order to study this subject. In Dr. Clerk's opinion, practical men very greatly underrate their indebtedness to theory. Some practical men have gone so far as to say that gas-engine designers have brought internal-combustion engines to their present state of efficiency without any aid from scientific theory. The increasing efficiency of the internal-combustion engine has put great pressure upon steam-engine builders, and recent steam turbine efficiencies have attained such figures that it becomes necessary for the gas-engine designer to attempt further economies in order to keep ahead of his steam rival. This he can do only by exact knowledge of his heat losses and properties of his working fluid.

We have received from Messrs. Gallenkamp and Co., 19 and 21 Sun Street, E.C., a catalogue of laboratory outfit for the bacteriological and pathological laboratory. All the general and special apparatus, as well as the necessary fittings, are included in the list, which is fully illustrated.

Catalogue No. 319, just issued by Mr. E. Baker, 14 and 16 John Bright Street, Birmingham, includes a number of rare and interesting works on many branches of science, offered at low prices. Librarians and others requiring volumes to complete sets or series, or papers on particular subjects, should see the catalogue.

Three new volumes in Prof. Ostwald's series of scientific classics—"Klassiker der exakten Wissenschaften"—published by Mr. W. Engelmann, of Leipzig, have recently been received. No. 188 (price 1.80 marks) is entitled, "Die Druckkräfte des Lichtes," and contains two papers by P. Lebedew on the pressure of light, with notes by P. Lasareff. A translation into German of A. C. Clairaut's work, published in 1743, on the theory of the shape of the earth, based upon hydrostatic principles, appears as No. 189 (price 4.60 marks), under the title, "Theorie der Erdgestalt nach Gesetzen der Hydrostatik," with notes by P. E. B. Jourdain and A. v. Oettingen. Similar valuable notes are contributed by R. Anschütz to No. 190 (price 5 marks), which contains J. Loschmidt's "Konstitutions-Formeln der organischen Chemie in graphischer Darstellung." Each of the volumes has a portrait of the original author as a frontispiece.

OUR ASTRONOMICAL COLUMN.

THE HOTTEST STARS.—Under this heading, Dr. Ant. Pannekoek communicates a short note to the *Astronomische Nachrichten*, No. 4657. It relates to the list of spectral-photometric measures made by Herr H. Rosenberg (see this column, May 29) of the temperatures of the hotter stars. Dr. Pannekoek states that from this list a regular increase of the figures takes places with the class-number of the spectra according to Miss Maury's classification. Whether this increase commences at the beginning or in which class the helium or the whitest or hottest stars are to be found cannot be clearly stated in consequence of the few stars discussed. Dr. Pannekoek utilises the large quantity of material available in the catalogue of colour-estimations by Osthoff, and while they give no results of absolute temperature, they are of value from a relative point of view. The comparison of these values with Miss Maury's types brings out the result that lowest colour number corresponds with her class IV. or IV.-V., or the typical helium stars. On either side of these classes the colour numbers increase, and the temperature decreases not only on the side of the Sirian stars of the first type, but also towards the Wolf-Rayet stars. The following is the complete table which he gives in the paper, but here Miss Maury's classes are preceded by the equivalents in Sir Norman Lockyer's classification for comparison:—

Class (Lockyer)	Class (Miss Maury)	Colour	No. of stars
Argonian	I	2·47	6
Alnitamian	II	2·36	10
Crucian	III	2·30	9
Crucian, Achernian	IV	1·94	14
—	IV–V	1·62	10
Taurian, Algolian	V	2·11	9
Rigelian, Algolian	VI	2·16	10
Algolian, Markabian	VII	2·27	23
Cygnian, Markabian	VIII	2·37	34
Sirian	IX	2·64	20
Sirian	X	3·11	14
Procyonian	XI	3·40	9
—	XI–XII	3·41	4
Polarian, Procyonian	XII	3·68	17
Polarian, Procyonian	XIII	4·12	13
Arcturian	XIV	4·45	12
—	XIV–XV	5·09	9
Arcturian	XV A	5·18	18
Arcturian	XV B	5·35	26
Arcturian	XV C	5·55	31
—	XV–XVI	6·34	5
Aldebarian	XVI	6·47	17
Antarian	XVII	6·80	15
Antarian	XVIII	6·74	15
Antarian	XIX	6·67	6

A PHOTO-VISUAL COMPARATOR FOR THE IDENTIFICATION OF MINOR PLANETS.—As the only means whereby a minor planet is distinguishable from a star of the same magnitude is its proper motion, its identification is often a matter of considerable labour proportional to the planet's magnitude and the uncertainty of the ephemeris. To this end M. J. Lagrula employs an ingenious arrangement which he describes in a note presented to the Paris Academy of Sciences (*Comptes rendus*, No. 15). It consists of a binocular combination of telescope and microscope, forming what is essentially a stereo-comparator, in which a coloured image of a photographic positive of the region to be examined is superposed on the image seen in the telescope. All objects visible in the field of the telescope, except small planets which have no counterpart on the photograph, are distinguished by the presence of a coloured disc. For use with the Gautier equatorial of the Nice Observatory copies of the photographic charts of MM. Palisa and Wolf have been found eminently suitable. As an example of the rapidity and efficiency of operating with the device the author instances detecting within five minutes an error in the published ephemerides of (233) Asterope.

METEOR DUST AS A MEASURE OF GEOLOGIC TIME.—In *Science*, No. 957, Prof. Alfred C. Lane directs attention to the possibility of using the proportion of contained meteor dust as a measure of the rate of formation of strata, and hence as a criterion of geologic time. He calculates that the earth gains 20,000 grams of cosmically derived nickel per square kilometre per annum. From this figure and the nickel content of the abysmal red clay he estimates that a layer one metre thick of the latter requires 8700 years to accumulate. The professor urges members of proposed polar expeditions to complete Nordenskjold's observations by determining the rate of deposition of cosmic dust, and optimistically anticipates that within this century there will be drilled a hole in the bottom of the sea which will give us the other datum to be determined.

THE ROYAL AGRICULTURAL SHOW.

THE extremely successful Royal Show held at Bristol, July 2–5, illustrated in a striking way the general progress being made in agriculture, horticulture, and forestry, but presented very little calling for comment from the scientific point of view. Among livestock, a remarkable novelty was the pen of primitive breeds of sheep—and crosses from the same—exhibited by Prof. Cossar Ewart and Mr. H. J. Elwes. This throws some light on the origin of domesticated sheep, and also suggests the possibility of establishing one or more new breeds capable of thriving on poor upland pastures in this country, and of yielding more valuable wool than that of the ordinary hill-breeds.

In the Agricultural Education Exhibition, Rothamsted showed an interesting series of tomato-plants in pots to demonstrate the advantage of partial sterilisation of soil in various ways. Wye College—as usual —exhibited a striking series of pests, fungoid (including a new disease of apple-buds) and insect (some in the living state). The University of Bristol was represented by the associated Royal Agricultural College (received in deputation by H.M. the King on July 4) and Long Ashton Fruit and Cider Institute. The chief feature of the former was a collection of wool-staples, including a series from the sheep in the above-mentioned exhibit of Ewart and Elwes. Long Ashton, as the chief British horticultural research centre, is evidently working with increased energy since its reconstitution and extension, and one of its most interesting exhibits consisted of specimens of a new disease of pear-blossoms, due to bacteria as yet unnamed, and causing the young fruits to fall early. The Nature-study Section, including exhibits from several western and south-western counties, was a decided improvement on past years, proving that school work is now more systematic than formerly. Gloucestershire is to be congratulated on classifying its material by subjects and not by schools.

The exhibit of British tobaccos attracted much notice, but most of those who sampled the specimens were not impressed by their quality, though no doubt home-grown material may prove useful for fumigation purposes. The Forestry Section was particularly good, and demonstrated increasing interest in a neglected industry of national importance.

Among the implements, the increasing necessity for labour-saving contrivances is evidently continuing to produce continual improvements and new types. The set of milking machines attracted a great deal of attention, especially the Swedish Omega form, of vacuum type, which gained first place in trials held earlier in the year. The difficulty of cleansing milking machines has been one of their great drawbacks, but this is largely overcome in the Omega by employing short transparent celluloid tubes instead of long rubber tubes. Probably the most ingenious new appliance to be seen in the show was the "Erto" potato-planting machine. This, in one operation, digs trenches of the desired depth, plants the tubers at any distance apart, sows manure if required, and covers up the furrows. Novelties were not wanting among the exhibits of various well-known firms specialising in farm and garden plants. Suttons showed a new variety of sunflower with red centre, Marsters new varieties of wheat, and Gartons a new oat—the "Leader"—the first to yield five grains to a spikelet.

The most striking innovation on a large scale at the Bristol Show was the establishment of an Overseas Section, and it is to be hoped that this feature may be permanently retained. So many persons are emigrating overseas that it is important to give them every chance of seeing Colonial produce and studying Colonial methods. Readers of NATURE are mostly familiar with the kind of exhibits represented in this section, but large numbers of the populace last week were obviously keenly interested in the rubber series shown by the Federated Malay States, and the sugar samples from the West Indies and British Guiana, including food products for human and animal consumption, and even a sugar-cane plant in a living and healthy state. The time appears to have come when intending colonists should all have the opportunity of elementary instruction in Colonial or tropical agriculture before leaving the home country.

J. R. A.-D.

BEDFORD COLLEGE FOR WOMEN.

THE opening of the new buildings of the Bedford College for Women on July 4 by her Majesty Queen Mary was an important event in the history of university education.

A committee was formed in 1847 by Mrs. Reid and other ladies interested in women's education, lectures being given in Mrs. Reid's private house, and in 1849 the college was definitely started in a house of its own in Bedford Square, from which fact the college takes its name. In 1874 the college moved to Baker Street, and from that year its growth has been rapid. As time went on the accommodation at Baker Street was increased until every available square foot was covered; when it became evident that a move into larger and less noisy buildings was inevitable. For this purpose the council acquired the lease of South Villa, standing on land adjoining but outside Regent's Park. Three acres of the site were added to the park, about eight acres being left for the purpose of the college and its grounds. An appeal was issued for the necessary building fund, and a loyal response was given by old students and other friends of the college. Among other gifts may be mentioned a library and its furniture by Lady Tate, a dining-hall and common-rooms by Mrs. Oliver, a grant of 30,000*l*. from the London County Council, and an anonymous gift of 30,000*l*.

The new college accommodates some 500 students, and (except for the library) was designed by Mr. Basil Champneys. It consists of four parallel rows of buildings: the library, a science block for chemistry, physiology, and physics, another science block for zoology, botany, and geology, and the hall and rooms for about eighty residents. These rows are connected at one end by corridors, by the Sir Julius Wernher reading-room, and by a block of buildings for administrative offices and for the rooms allotted to arts subjects and mathematics. This "arts" block also contains a large hall for public lectures.

In erecting these buildings the council has assumed a heavy responsibility, and in order to provide scholarships, to maintain the departments at a high level, and to keep up the fabric, an adequate endowment is urgently needed. An appeal has been issued for an endowment fund of 150,000*l*. A far humbler but very necessary appeal was also issued about a year ago for 2000*l*. to put the athletic clubs on a sound financial basis. The value of outdoor recreation to women coming from London homes, and engaged in severe mental work, can scarcely be over-estimated.

The Queen, who was accompanied by Princess Louise Duchess of Argyll and the Duke of Argyll, was received at the entrance of the college, and conducted by the Earl of Rosebery to the lecture-hall, where the council and staff were presented. She then proceeded to the two science blocks, where she inspected the students at work, and took the keenest interest in their experiments and exhibits. Afterwards she walked to the Tate Library, and then to the residents' block, where she visited some of the rooms. Meanwhile some 600 guests were awaiting her arrival in the dining-hall, the time being filled up by several speeches. The President of the Board of Education expressed strong appreciation of the work done by the college, and hopes of a great development of both school and university education in the future. In the absence of Sir John Simon, Miss Edgell (head of the department of philosophy) spoke next, and in an interesting speech outlined the progress of women's education during the last sixty years, and emphasised the great part played therein by the University of London. The Archdeacon of London pointed out the value of university education in the formation of national character. Then Lord Rosebery spoke until the Queen, having completed her tour of inspection, arrived in the hall, where she listened to a college song and received a bouquet from the students. She then said: "I have great pleasure in declaring the new buildings of this college open"; and left the college, after receiving thanks from Lord Haldane.

RUSSIAN GEOGRAPHICAL PAPERS.

Lake Balkhash.—Mr. B. F. Meffert, who visited this lake during a journey in Russian Asia in 1910, has given an account of its basin in the *Izvestiya* of the Imp. Russ. Geogr. Soc., Nos. i.–v., 1912. The basin is intimately connected with those of the lakes Sasyk-kul, Ala-kul, and Ebi-nor. The rocks are chiefly Palæozoic and eruptive rocks of various ages. Deposits dating no further back than the Tertiary are rare, and occur only in the eastern part of the basin. At some time or other before the Tertiary period the Palæozoic rocks were folded in various directions, chiefly north-west and west. When the faulting and upheavals which formed the horsts and troughs of the Tarbagatai, Dzungarian Alatau, the Chu-Ili watershed, &c., took place is not known, but in some parts they may be referred to the Tertiary period, and also the subsidence, at least of the western part of the basin, is probably of the same age. Mr. A. M. Nikolski has connected Balkhash with the Han-hai, not with the Turkestan basin, believing that the Han-hai with Balkhash was isolated before the separation of the Aralo-Caspian sea from the Siberian, and certainly no Aralo-Caspian deposits occur for some distance west of Balkhash. Marks of high water are found on the north-west of the lake 100 ft. above the present level, and therefore the lake must at one time have covered a large area to the south and east. According to Golubief, the lakes Sasyk-kul, Uyali, and Ala-kul formed one lake within the memory of man, and the difference of level between Ala-kul and Ebi-nor is only 25 ft. During last century there was a long period of desiccation, but for the last twenty years the lake has been rising. The water of the western part of the lake, into which the Ili pours considerable volumes, is quite sweet, but it is brackish in the small bays and channels.

Floral Regions of Siberia.—In the Bulletin of the Imp. Academy of Sciences in St. Petersburg, No. 14, 1912, Mr. N. I. Kuznetsof proposes a division of Siberia into floral regions, after discussing those of Ledebour, Korzhinski, and Tanfilyef. A line following the watershed between the Yenesei and Lena, approximately coinciding with geological and climatic boundaries, prolonged northwards to the watershed between the Khatanga and Anabara, and southwards to the mountains at the southern end of Lake Baikal, divides the principal regions into eastern and western parts. In the western section of the forest area arboreal species of the Altaic or western Mongolian centre prevail, in the eastern those of the Manchurian centre. Beyond the limit of arboreal vegetation determined by Siberian travellers, notably Middendorff, is the Arctic zone, its eastern part characterised by species and even families common to the Arctic regions and America, and also by representatives of the Alpine flora of the Stanovoi and Verkhoiansk ranges. Kamchatka and the Okhotsk coast down to the north of Sakhalin constitute a separate division, in which Altaic forms are absent, and peculiar species of trees, *Picea ajanensis*, *Abies nephrolepis*, and *Betula Ermanni*, occur. Foliage trees are seldom found in Siberia except in the Amur district, where Tertiary forms exist which perished in other parts of Siberia during the cold period contemporaneous with the Ice Age of Europe. The Alpine region is confined to islands and bare summits amidst the sea of coniferous forests, in the Verkhoiansk and other ranges. East of Lake Baikal *Pinus pumila* occurs, species which thrive on rocky peaks are few, and the flora passes at the north-eastern extremity of the Yablonovoi range into the Arctic flora. Lastly, there are two areas of steppe-lands, one in the west between the southern limit of the *taiga*, and the watershed between the Arctic ocean and the Aralo-Caspian depression, the other embracing the basins of the Shilka, Argun, and the Upper Amur, as far as Albazin.

Natives of Siberia.—According to Mr. S. Patkanof (*Zapiski* of the Imp. Russ. Geogr. Soc., Statistical Section, vol. xi., No. 1), the natives of Siberia number 870,536, of whom 442,459 are males. This sex generally preponderates, except in a few small tribes. The most numerous are the Buriats, who number 288,599. As regards governments, Yakutsk contains the largest number of natives, namely 235,623, and they constitute 87·5 per cent. of the total population. In Transbaikalia and Irkutsk they are also numerous, while they are few in the Amur province. There are, however, districts of Siberia where the natives are almost all the population. The other inhabitants of Siberia, chiefly Russians, number 4,889,633, so that the natives constitute only about 15 per cent. of the total population.

METEOROLOGICAL REPORTS AND SUMMARIES.

A USEFUL discussion of the cloudiness and sunshine of North America, by Mr. A. Gläser, is contained in *Aus dem Archiv der Deutschen Seewarte*, vol. xxxv., No. 1, based on published data from available sources. The subject is treated in considerable detail as regards time and place, and is illustrated by copious tables and diagrams. The few following points may be mentioned among the general features referred to. In the westward districts westerly winds bring most cloud, clear sky in summer being due to the higher saturation point of the air. Eastward of the Rocky Mountains the sky is clearer, but with northerly and southerly winds the spring is the most cloudy season. The winter barometrical minimum in the North Atlantic causes easterly winds in the eastern States, and these, mixing with the relatively warm air of the coast, produce a large amount of cloud. The high pressure in the south-east in autumn causes clear weather; in the south the greatest clearness occurs towards the end of winter. In the south-west of the United States and western Mexico the warm winds of the Gulf of California cause much cloud in summer; the clearest season is spring, and the dry northerly winds of the northern portions bring clear weather in autumn. The most bright sunshine is found in the south-west of the continent, and the least in the north-west and north-east, where the sun's power is naturally much weaker. In the region east of the Rocky Mountains there is comparatively little change in proceeding from south to north.

The Rev. L. Froc, S.J. (director of the Zi-ka-wei Observatory, near Shanghai), has issued the first part of a useful discussion of the rainfall in China during eleven years, 1900–10; the paper also includes data for a number of stations for shorter periods. Full particulars are given respecting the geographical position and surroundings of each station. In addition to the sums for individual months and years, and means for seasons and for the whole period, interesting details are given with reference to the variability of rainfall and unusual falls in the yearly, monthly, and daily periods, but the general discussion of the data and preparation of a rainfall map are reserved for the second part of the paper, to be published later on. It is remarked that the rainfall is not so excessive as in some neighbouring countries, *e.g.* the Philippine Archipelago. The following are among the heaviest of the yearly falls:—Hongkong, 2473 mm., in 1902; Fouchow, 2572 mm., in 1906; Sanchoei, 2760 mm., in 1907; Pakhoi, 2691 mm., in 1908; all in the south-east of China. The greatest daily fall was 320 mm. (12·6 in.) at Pakhoi. The diagrams show that in all districts the greatest rainfall occurs during the summer half-year.

The Commonwealth Central Weather Bureau has issued an average rainfall map of Tasmania, the fifth of the series showing the annual rainfall distribution of Australia. The most striking feature of the map is the great variation between the greatest and least average falls, viz. 17·9 in. at Beaufront, in the midland district, and 115·8 in. at Mt. Lyell, on the west coast. This coast is exposed to the moist westerly winds, and condensation is favoured by physiographic conditions, the result being a mean annual fall of 88·7 in. for the whole district generally. On the east coast the annual mean is 32·7 in. For a large area (about 3000 square miles) no records are available.

The annual report of the meteorological observatory of the Government-General of Korea for the year 1911 (Dr. Y. Wada, director) contains valuable observations taken three times daily at ten stations, with carefully prepared summaries. Weather conditions and special occurrences are denoted by international symbols, and the instruments and methods of observation are similar to those at meteorological stations in Japan, and, consequently, are all that can be desired. The absolute maxima of air temperature ranged between 88·3° F. at Fusan and 92·8° at Chemulpo, both in August, and the absolute minima between −16·1° at Ping-yang and 15·3° at Mokpo, both in January. The yearly rainfall varied from 33·3 in. at Song-chin to 76·8 in. at Fusan. The largest amount of sunshine was 2642 hours, at Ping-yang, being 60 per cent. of the possible quantity.

A report on the Mariout district, by Mr. A. L. P. Weedon, in Nos. 72 and 73 of *The Cairo Scientific Journal*, is of much interest, both from an agricultural and from a meteorological point of view. The district, which consists of a long strip of land west of Alexandria, was in ancient times famous for its fertility, but at present it is for the most part barren and waste, barley being practically the only crop grown, in some parts only, and this is dependent on the somewhat precarious winter rains. The rainfall seems to differ but slightly from that of Alexandria, which averages 220 mm. (8·7 in.) per annum. The climate depends on the temperature of the Mediterranean and the general atmospheric circulation, and from numerous quotations from ancient and modern writers it is concluded that there is no reason to believe that either of those factors, or the rainfall, has changed since Roman times. The author states that the land is capable of producing more profitable crops in the hands of more efficient cultivators, who by the employment of scientific methods could either give it a better or more regular water supply, or make a better use of the existing moisture of the soil, *e.g.* by a system of dry-farming (economising the rain-water by digging trenches before the rainy season), assisted by wells and cisterns, many of which already exist.

The Austrian Meteorological Institute has published part v. of its valuable "Klimatographie" of that country, referring to the mountainous province of Salzburg. Climatologically, Salzburg belongs to the Central European district, but owing to the Alps it is subject to many marked modifications. The portion on the northern side of the limestone Alps, being exposed to the north and north-west winds, has a decidedly damp and rainy character, with the peculiarities of the West European climate. But between the limestone and central alpine chain lies a zone of a continental, dry character, with stagnant masses of air (*Luftseen*) in the valleys, in winter excessively cold, and relatively warm in summer. In the Lungau district, Salzburg participates in the rough, inhospitable climate of the upper Mur valley. The author, Dr. A. Fessler, adopts in the main this general subdivision of the climatic conditions in his elaborate discussion, dealing with each district in great detail, and with full consideration of the effects of aspect and altitude on temperature, rainfall, and climate generally. The discussion is based on observations made at stations connected with the Central Institute, but the author is handicapped by the paucity of data in many points of climatological importance; from this point of view Salzburg compares unfavourably with other alpine districts; complete observations for, say, twenty years and upwards only exist for comparatively few stations.

GREAT ADVANCE IN CRYSTALLOGRAPHY.[1]

CRYSTALLOGRAPHY has made such remarkable progress during the last few months, and the position at the present moment is so interesting, that it was considered opportune to review it in a discourse from this historic lecture-table.

Overwhelming evidence has now been brought forward that a crystal is endowed with a definitely organised structure.[2] In the crystal of a pure substance we are dealing with a chemical element or compound, and if with the latter it may be of any grade of complexity, from a very simple binary compound to a most highly complicated one composed of a large number of atoms. If the crystal be that of an element the structure is obviously composed of the similar atoms of that element, while if it be a compound we have a structure composed of atoms of as many kinds as there are chemical elements present combined in the substance, and in the same relative proportion as is expressed by the chemical formula of the substance. In the case of a compound, moreover, the structure may also be considered to be that of the molecules of the substance, for they or a simple arrangement of a small number (group) of them form the grosser units of the structure, whilst the atoms are the ultimate units.

Suppose we now represent this molecular or polymolecular grosser structural unit by a point, and that such point be analogously situated within each unit. The essence of crystal structure then is that these points are so arranged in space that if they are joined along the three directions of space by imaginary lines the latter form a "space-lattice" (German, "Raumgitter"), each unit cell of which may be conceived to be the "brick" already alluded to in the earlier part of the lecture, and the domicile of the chemical molecule or group of molecules (indeed, it is immaterial whether the points are considered as placed at the corners or in the centres of the cells) or, in the case of an elementary substance, of a group of similar atoms. We may, therefore, define a crystal as follows:—

"A crystal of any definite chemical substance consists of a homogeneous arrangement of grosser units of matter, each consisting of one chemical molecule or a small group of molecules of the substance, and the kind of arrangement is such that these grosser units are all identically (sameways, parallel-wise) orientated, and that their analogously chosen representative points, one from each such grosser unit, form a space-lattice (Raumgitter)."[3]

There are fourteen kinds of space-lattices, slides of several of which are exhibited on the screen. Three possess full cubic symmetry, two are tetragonal, four are endowed with rhombic symmetry, and two are monoclinic; while triclinic, trigonal, and hexagonal crystals have each one space-lattice corresponding to their type of symmetry. In every case it is the full (holohedral) symmetry of the system which is present, no space-lattice possessing merely the lower degree of symmetry corresponding to one of the so-called hemihedral or tetartohedral classes of the system in question.

Now in the solid crystal, not only are the grosser

[1] From a discourse delivered at the Royal Institution on Friday, March 14 by Dr. A. E. H. Tutton, F.R.S.

[2] This was very fully illustrated by numerous experiments during the first portion of the discourse.

[3] Since this lecture was delivered (March 14) and printed by the Royal Institution, a paper by Prof. Theodore W. Richards, of Harvard University, has appeared in the Journal of the American Chemical Society for April (vol. xxxv., p. 381), in which he shows that his theory of compressible atoms leads to "crystal units" of precisely the molecular or polymolecular character described in this lecture. He supposes such crystal units to be the entities necessary to relieve metastable supersaturation, and their centres to form the points of the crystal space-grating, assumptions with which the lecturer obviously fully concurs.

units arranged so that their representative points are repeated in space with extraordinary accuracy of position, with production of unit cells or "bricks" of absolutely identical dimensions throughout the crystal, but the shapes of the grosser units themselves are identically similar and identically similarly orientated in space. Suppose, however, that the force of crystallisation, the directive molecular force concerned in bringing the molecules together in this regular order of marshalling, is only adequate just to attain this marshalling of the grosser units into a space-lattice formation, without being able to fix the units about their own centres of gravity, a certain amount of wobbling about the latter being still permitted. We might, in such circumstances, expect that some of the properties of a crystal, dependent on the space-lattice formation on lines of definite symmetry, such as the optical properties of double refraction and polarisation of light, would be developed and exhibited, while the production of exterior plane faces would be either only partial, with rounded edges and the exhibition of plasticity and viscosity, or would not be achieved at all, the objects produced being still fluid. One cause of such a condition of partial success at crystallisation might well be that the substance was composed of a large number of atoms arranged in a long chain, such as the well-known "long chain compounds" of organic chemistry, which would offer considerable resistance to marshalling. The author believes that herein lies the explanation of the remarkable "liquid crystals" which Prof. Lehmann has made the subject of his particular study, many of which are of just such long-chain character.

FIG. 1.—Liquid crystals of ammonium oleate.

By the kindness of Prof. Lehmann, who has sent over specimens of some of the most characteristic of his substances for the special purpose of this lecture, and of Mr. Poser, of Messrs. Zeiss, who construct an admirably convenient form of heating microscope and projection arrangement for demonstrating the formation of liquid crystals and their behaviour in polarised light, it is possible to exhibit some of the typical phenomena of these interesting objects on the screen. The substances in question are chiefly such as form two or more polymorphous forms, each stable within a limited range of temperature, and the liquid crystals are usually the second phase observed on allowing the truly liquid heated substance to cool; the liquid crystal phase is produced at a definite temperature during the cooling, and persists throughout a definite interval of temperature during the continued cooling.[4] The view here put forth is apparently in agreement with that of Lehmann himself, as most recently expressed both in letters to the lecturer and in a memoir of July 27, 1912, to the Heidelberg Akademie der Wissenschaften, in which he says that in all probability: "Die Rundung der Formen hänge zusammen mit der Plastizität der Stoffe und habe ihren Grund in unzureichender molekularer Richtkraft, welche wohl genügt, ein Raumgitter herzustellen, nicht aber regelmässige Treppenstufen, wie es nach Hauys Theorie zur Bildung ebener Krystallflächen nötig wäre." The formation of regular stepped faces (of invisibly minute steps, "Treppenstufen") the lecturer considers to occur only when the grosser units become fixed about their centres of gravity or representative points, with production of a truly solid crystal.

But now let us pass to the consideration of the internal structure of the grosser or space-lattice units themselves. Their symmetry may be, in simple cases, similar to that of the space-lattice, but in general this will not be so. Whatever the stereometric arrangement of the chemical atoms in the molecule may be, and, if more than one molecule goes to form the space-lattice unit, whatever their mutual arrangement, and therefore whatever be the outer configuration of the whole unit, when the crystal is a truly solid one, the force of crystallisation (now no longer denied) is adequate to fix each space-lattice unit, not only considered as a point with reference to its neighbours, but as regards its shape and its whole character, parallelwise and sameways orientated with respect to its adjacent fellows, and as close as possible to them. Also, if more than one molecule goes to each space-lattice unit, their mutual arrangement is achieved on a definite plan, and is the same for every space-lattice unit; these constituent molecules of the latter are also as closely packed as possible. The final result is thus to produce an assemblage of chemical atoms in which not only the demarcation frontier between the space-lattice units disappears, but also that between the constituent molecules in the cases of polymolecular grosser units. We come, ultimately, in consequence, to a structure of atoms each of which we may represent by a point.

Now, just as the genius of Frankenheim and Bravais revealed to us the fourteen kinds of space-lattices, so Sohncke made us acquainted with sixty-five regular systems of points, including many of the thirty-two classes of symmetry, but not all, which von Lang had shown crystals to be capable of possessing. Later the number was brought up to 230 by simultaneous and wonderfully concordant geometrical researches by Schönflies in Germany, von Fedorow in St. Petersburg, and Barlow in England, and among these 230 all the thirty-two crystal classes are represented, and no others.

Hence, we come to the conclusion that the skeletal framework of crystal structure is the molecular or polymolecular space-lattice, and the detailed ultimate

[4] Ammonium oleate (Fig. 1), para-azoxyanisol, para-azoxyphenetol, and cholesteryl acetate were illustrated on the screen.

structure the atomic point-system. The latter determines the class of symmetry (which of the thirty-two classes is exhibited), and therefore governs any hemihedrism or tetartohedrism, as the development of less than full systematic symmetry used to be called. But it is the space-lattice which governs the crystal system, that is, which determines whether the symmetry is cubic, tetragonal, rhombic, monoclinic, triclinic, trigonal, or hexagonal, and also determines the crystal angles and the disposition of faces in accordance with the law of rational indices, the law which limits the number of possible faces to those which cut off small whole-number relative lengths from the crystal axes. Indeed, it is because only those planes which contain the points of the space-lattice are possible as crystal faces that the law of rational indices obtains. For any three points of the space-lattice determine a plane in which similar points are analogously regularly repeated, and which is a possible crystal face obeying the law of rational indices. Moreover, those facial planes which are most densely strewn with points are of the greatest crystallographic importance, being what are known as the primary faces, either parallel to the crystal axes or cutting off unit lengths therefrom, as well as being usually the planes of cleavage.

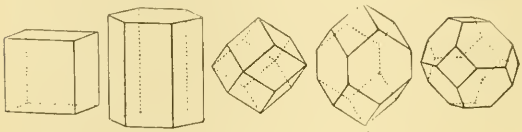

FIG. 2.—Fedorow's types of parallelohedra.

As the space-lattice units are all sameways orientated, any one atom of the molecular or polymolecular grosser unit might be equally well chosen as the representative point of the lattice, so long as a similar choice were made in every space-lattice unit, and the resulting space-lattice would be the same whichever atom were so selected. Consequently, the space-lattice is afforded by the similarly (identically) situated atoms of the same chemical element throughout the crystal structure. The combined point-system (one of the 230 possible point-systems) may thus be considered to be built up of as many identical but interpenetrating space-lattices as there are atoms in the space-lattice grosser unit. These facts are concisely expressed in the definition of crystal structure which was stated as follows by Prof. von Groth at the Cambridge meeting of the British Association in 1904:—

"A crystal—considered as indefinitely extended—consists of n interpenetrating regular point-systems, each of which is formed from similar atoms; each of these point-systems is built up from n interpenetrating space-lattices, each of the latter being formed from atoms occupying parallel positions. All the space-lattices of the combined system are geometrically identical or are characterised by the same elementary parallelepipedon."

Having thus arrived at a comprehensive idea of crystal structure on the assumption of each atom and each grosser space-lattice unit being only a point, as far as which we are on safe and assured ground, we may proceed to the consideration of the various ideas advanced concerning the character of the units of structure thus represented by points; that is, concerning the mode in which the space around the point is more or less filled up.

The valency theory of Barlow and Pope considers the atomic point to be expanded into the sphere of the atom's influence, the relative size of which in any one substance is supposed to be proportional to the fundamental valency of the chemical element of which the atom is composed. The spheres are further assumed to be pressed together on crystallisation until they fill space, becoming thereby deformed into polyhedra. The theory of von Fedorow, on the other hand, considers the grosser or space-lattice units to be parallelohedra; besides those corresponding to the fourteen space-lattices there are nine other parallelohedra (making twenty-three in all) composed of simple Sohnckian point-systems compounded of interpenetrating space-lattices. All the twenty-three parallelohedra are arranged parallelwise, and fill space without interstices. There are, however, only four types, namely the cube, the rhombic dodecahedron (which has a second vertically elongated variety), the cubo-octahedron, and the hexagonal prism, the first three being all of cubic symmetry, and the fourth of obviously hexagonal symmetry. They are shown, including the second variety of the dodecahedron, in the next screen picture (Fig. 2). He further considers that all four may be homogeneously deformed into analogous parallelohedra of lower orders of symmetry, without ceasing to fill space when closely packed. Hence, von Fedorow concludes that all crystal structures are of either cubic or hexagonal type, including not only truly cubic and hexagonal crystals, but their deformed derivatives.

Unlike the atomic polyhedra of Pope and Barlow, these parallelohedra of von Fedorow are either molecular or polymolecular, in the latter event being made up of a small number of identically or symmetrically similar subpolyhedra, termed by him "stereohedra," which represent the chemical molecules, just as already explained, when the grosser space-lattice unit is polymolecular, the stereohedra being arranged to build up

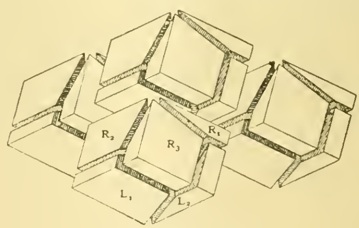

FIG. 3.—Fedorow's stereohedra.

the main parallelohedron (the space-lattice unit) on a definite plan, which may involve mirror-image juxtaposition. For example, a rhombohedral system of stereohedra is shown on the screen (Fig. 3), consisting of two kinds, R and L, one sort being the mirror-image of the other. Each rhombohedron representing the combined system is composed of six stereohedra, three of each kind, and a series of points, similarly situated one within each stereohedron R, would constitute a Sohncke point-system, while a "double-system" is obtained by adding a series similarly situated one within each stereohedron L. If a single point were taken to represent analogously each rhombohedral set of six stereohedra, we should have a rhombohedral space-lattice produced.

The valency theory of Barlow and Pope may or may not in the sequel prove to be correct, and some facts have recently been brought forward by Barker which tend to show that it will not hold in many cases of inorganic substances. Barker, who has had the good fortune to have worked in St. Petersburg with von Fedorow for more than a year, shows that, as the lecturer has always held, the true unit of volume is the molecular or atomic volume, as determined for the particular substance itself. The molecular volume is determinable by dividing the molecular weight of the substance by the specific gravity of its crystals at a definite comparable temperature, such as 20° C., but the determination of the atomic volume offers peculiar difficulty, and so far only comparative and indirect methods have been employed, chiefly by Sollas. By taking the volumes of the spherical units to be proportional to the atomic volumes (not those of the element in the free state, as enormous compression occurs on combination), and also determining the amount of free interstitial space by comparative methods of calculation, Sollas has achieved some remarkable explanations of the crystallographic characters of the two polymorphous forms of silver iodide and of the three forms of titanium dioxide, rutile, anatase, and brookite. It would not be surprising if the valency volumes of Barlow and Pope, in the cases of those elements for which their theory appears to work in a satisfactory manner, turn out to be identical with the atomic volumes as determined by the method of Sollas. As regards the compounds of carbon and hydrogen, Barlow and Pope have been most successful in accounting for crystallographic and chemical relationships, and it is at least significant that both Le Bas, from experimental work on the molecular volumes of liquid hydrocarbons, and Traube from an entirely different point of view, concur in assigning the relative volumes 4 and 1 to carbon and hydrogen atoms in combination respectively. If Traube's results for carbon and hydrogen be acccepted, so must also those for the relative volumes of the atoms of the halogens, sulphur, oxygen, and nitrogen, his values being: $F=1$; Cl, Br, and $I=7$ each; $S=6$; $O=2$; and $N=3$. As regards oxygen and nitrogen, he agrees with Barlow and Pope, but the latter take all the halogens as of unit valency volume, and sulphur as of valency volume 2. Barker shows that while in the binary sulphides, such as zinc sulphide ZnS, the sulphur is probably of volume 2, in the sulphates, such as K_2SO_4 and $BaSO_4$, it is probably 6, as Traube insists; this conclusion is also in agreement with other work of Barker on some extraordinary cases of isomorphism, including that of barium sulphate with potassium perchlorate $KClO_4$, potassium permanganate $KMnO_4$, and the extraordinary compound potassium borofluoride KBF_4.

While it would thus appear that the atomic volume (in the substance itself, and including any interspace) is the true effective volume concerned in crystal structure, and that it may be only a coincidence that, in the cases of a few prominent elements, it happens to be approximately proportional to the valencies of those elements (as certainly appears to be true in the cases of hydrogen and carbon, and possibly oxygen and nitrogen), there is a very considerable amount of the joint work of Barlow and Pope which is of permanent value. Their explanations of the preponderating cubic and hexagonal crystalline forms of the elements themselves, and of binary compounds such as ZnS, are doubtless correct, and it will be of great interest, in view of the next development to which attention must be directed, to illustrate the case of zinc sulphide.

Barlow and Pope's idea of the structure of zinc blende, which merely assumes that the volumes of the atoms of zinc and sulphur are approximately equal, is that sixteen molecules ZnS go to form the grosser unit of the crystal structure, the combined system or space-lattice unit—that is, sixteen atoms of zinc and sixteen of sulphur. Only one zinc or one sulphur atom in every sixteen is sameways orientated, and if we adopt von Groth's definition, we may give the structure of zinc blende as follows:—The crystals of zinc blende consist of two interpenetrating regular point-systems, one formed from zinc atoms, and the other from sulphur atoms; each of these two point-systems is built up from sixteen interpenetrating space-lattices, each of the latter being formed from zinc atoms or from sulphur atoms occupying parallel positions. All the thirty-two space-lattices of the combined system are geometrically identical.

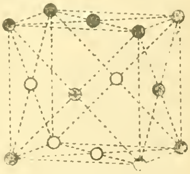

FIG. 4.—Space-lattice of centred-face cube.

Barlow and Pope have shown that the space-lattice in zinc blende is the third cubic one, in which a point is situated at each cube corner and also in the centre of each cube face. For this is the space-lattice corresponding to an assemblage of spheres of equal volume in closest packing. The space-lattice in question is shown on the screen (Fig. 4), and a pair of models of the arrangement are illustrated in the next two pictures, in the first of which the points are expanded into spheres of considerable size, and in the second they appear still further expanded into actual contact. The third stage, in which the expansion proceeds until all interstices are filled up and the spheres are converted into polyhedra, is left to the imagination. In the second picture (reproduced in black and white in Fig. 5) the mutual arrangement

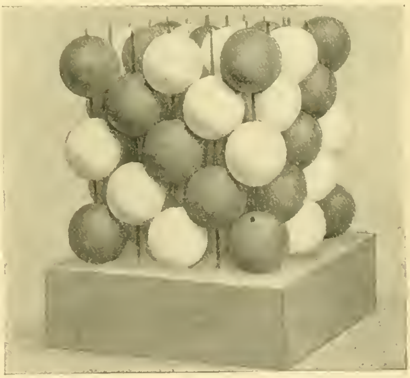

FIG. 5.—Model of arrangement of zinc atoms (shaded) and sulphur atoms (light) in zinc blende.

of the spheres of the two elements in zinc blende, zinc and sulphur, is indicated by the yellow colouring of the sulphur spheres and the grey tinting of those of zinc. The tetrahedral mode of derivation of the structure, accounting for the observed hemihedrism, is also shown in another slide (Fig. 6). The eight larger cubes which together form the grosser unit are each supposed to be occupied by four smaller cubes of the same element, arranged tetrahedrally, and of zinc and of sulphur alternately in different larger cubes; on replacing the little cubes by spheres in contact the model represented in the second picture (Fig. 5) is produced.

Now this crystalline mineral, zinc blende, has been chosen advisedly as an example of crystal structure. For a remarkable series of experiments have recently been carried out by Laue, Friedrich, and Knipping at Munich, where the lecturer had the advantage of seeing some of the first photographic results last summer. In these experiments X-rays were passed through crystals of various substances, notably zinc blende, and, in more recent experiments by Laue at Zurich,

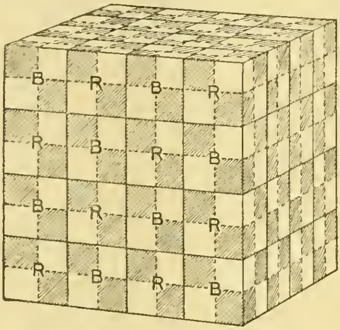

Fig. 6.—Scheme of tetrahedral arrangement of zinc (B) and sulphur (R) atoms in zinc blende. Unshaded cubes unoccupied.

quartz. The issuing rays were received on a photographic plate, on which they recorded a pattern of spots having the symmetry (full holohedral) of the space-lattice present as the foundation of the crystal structure. These interesting photographs thus afford the first experimental and visible proof of the truth of the structure assigned to crystals by geometricians and crystallographers.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Birmingham.—At the annual Degree Congregation the degree of Doctor of Science was conferred on the following:—E. E. Fournier d'Albe, Hamilton McCombie, George William Todd, and Donald Levy. The occasion was also marked by the unveiling of a fine portrait of the Chancellor (the Right Hon. Joseph Chamberlain), the generous gift of Mrs. Chamberlain, "as a token of my own interest in all that concerns the University, and my earnest hope that future generations will see it develop into all that its founders dreamed of when it was established."

Edinburgh.—The honorary degree of LL.D. was conferred on July 4 by the University on Mr. H. A. L. Fisher, Vice-Chancellor of the University of Sheffield; Emeritus Professor Greenfield; Sir James Guthrie; Lord Justice Hamilton; Mr. John Stewart, Nova Scotia; Prof. F. Strassmann, Berlin; Prof. J. Arthur Thomson; the Hon. James Wilson, Washington, U.S.A.; and (*in absentia*) Prof. Thomas Gilray, University of Otago, N.Z.

Prof. C. G. Barkla, F.R.S., professor of physics in the University of London (King's College), has been appointed to the vacant chair of Natural Philosophy, in succession to the late Prof. J. G. MacGregor.

Prof. J. W. Judd, C.B., F.R.S., has been appointed emeritus professor of geology in the Imperial College of Science and Technology by the council of the college.

Mr. Andrew Carnegie has intimated to M. Liard, Vice-Rector of the University of Paris, that he will give 4000*l.* towards the construction of the new chemical institute which is being erected in the Rue Pierre-Curie, Paris.

Dr. L. H. Bailey, widely known as the chairman of President Roosevelt's commission on country life, has resigned the post of head of the New York State College of Agriculture, Cornell University, after a tenure of ten years. He has held the professorship of agriculture at Cornell since 1883. Dr. Bailey is resigning in order to secure more time for research.

Among recent Irish appointments we notice that Prof. Gregg Wilson, professor of zoology in Queen's University, Belfast, has been appointed a member of the first Senate of the University in succession to the late Prof. John Park. Mr. Edgar H. Harper has been appointed professor of mathematical physics in University College, Cork, and Mr. E. W. Hoare lecturer in veterinary hygiene in the same college.

Recent changes at Johns Hopkins University include the promotion of Dr. J. E. Gilpin, now associate professor of chemistry, to be collegiate professor, and of Mr. E. W. Berry, now associate in palæobotany, to be associate professor of palæontology. Prof. D. S. Johnson is appointed to the directorship of the botanical laboratory and the botanical garden, and Prof. Burton E. Livingston to the directorship of the laboratory of plant physiology.

Columbia University and Rutgers College receive bequests which may amount to 200,000*l.* each as principal beneficiaries under the will of Mrs. Mary B. Pell, the widow of John H. Pell. *Science* states that each beneficiary received a direct bequest of 40,000*l.* and an interest in large trust funds amounting to more than 400,000*l.* The fund for Columbia is to erect Pell Hall, in memory of the late Mr. Pell, who was a student of Columbia. From the same source we learn that Princeton University has received 20,000*l.* from Mrs. Russell Sage toward the construction of a dining-hall; and that the College of Agriculture of Cornell University has received a State grant of 90,000*l.*, and a grant of 14,000*l.* for the veterinary college. A part of the additional grant this year is to be used for increasing salaries.

Recent correspondence between the Maharaja of Darbhanga, who is at the head of the movement to create a Hindu University in India, and Sir Harcourt Butler, the education member of the Governor-General's Council, has, we learn from *The Times*, been published. The Maharaja points out that the subscriptions promised amount to more than 533,333*l.*, of which about 140,000*l.* has been received. Taking into account the capital value of certain grants of property and annual payments in perpetuity granted by three ruling chiefs, he estimates the amount in hand, or which may be safely taken as already in hand, to be not far short of 400,000*l.*, exclusive of the value of the Central Hindu College at Benares. He claims that a good case had been made out financially for the Government to take into consideration the legislation necessary for bringing the University into being. Sir Harcourt Butler has replied that the matter is still under consideration; but he thinks it will be of assistance to the promoters to know the conditions which the Government of India regards as precedent to the introduction of any scheme. These are the provision of a suitable site; the transfer of the Central Hindu College to the University; and the collection of not less than 333,333*l*. In this amount may be included the capitalised value of the property mentioned by the Maharaja, and the perpetual grants by three ruling chiefs, provided that the documentary title is satisfactory in the case of the latter, and the possession of the property has been made over in the case of the former. The further conditions are that the constitution of the University should proceed on lines to be indicated by the Government, and that a committee be appointed to report whether the Central Hindu College is fit to be developed into a residential and teaching university.

THE unusual increase in the number of women attending German universities, as shown by statistical returns recently issued in Germany, is of particular interest in view of the fact that women were only admitted as students in the summer of 1905. A note in the issue for July 4 of the Journal of the Royal Society of Arts states that during 1912 the number of women students in German universities has grown from 2795 to 3213, and the percentage of women now in the universities, as compared with the whole student body, is 5·4 per cent., as against 2·7 per cent. three years ago. Of the present body of women students the great majority—2900—come from Germany. Of the foreign women, Russia furnishes more than a third, America about a fourth, and other European countries most of the others. Few women students come from Asia, Africa, or Australia. The University of Berlin alone has more than one-fourth of the total women students of the Empire, the exact number of women in the large universities at present being:—Berlin, 904; Bonn, 289; Munich, 262; Göttingen, 237; Heidelberg, 219; Freiburg, 189; Münster, 172; Breslau, 150; Leipzig, 129; Marburg, 126; Königsberg, 107; Greifswald, 83; Halle, 81; Jena, 65; Strassburg, 52; Kiel, 40; Tübingen, 38; Giessen, 24; Erlangen, 21; Würzburg, 16; Rostock, 6; all others, 3. The departments of study to which the women students give preference are about the same as in former years, the enrolment in certain courses being:—Medicine, 702; mathematics and natural sciences, 579; economics and agriculture, 91; dentistry, 17; and pharmacy, 8.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 26.—Sir Ronald Ross, K.C.B., vice-president, in the chair.—F. S. **Phillips**: Phosphorescence of mercury vapour after removal of the exciting light.—Dr. G. J. **Burch**: Light sensations and the theory of forced vibrations.—P. W. **Burbidge**: The fluctuation in the ionisation due to γ rays.—J. G. **Leathem**: The force exerted on a magnetic particle by a varying electric field.—Dr. W. **Watson**: The luminosity curve of a colour-blind observer.—Prof. W. M. **Hicks**: A critical study of spectral series. Part iii.: The atomic weight term, and its import in the constitution of spectra.—L. C. **Martin**: A band spectrum attributed to carbon monosulphide. A complex band system occurring in the spectrum of the electric discharge through carbon disulphide vapour in addition to the bands due to sulphur, is also found in the spectrum given by sulphur in the carbon arc. These bands only occur in the presence of both sulphur and carbon, and are probably due to carbon monosulphide.—Igerna B. J. **Sollas** and Prof. W. J. **Sollas**: The structure of the skull of Dicynodon as revealed by serial sections. The structure of the skull has been demonstrated in a remarkably complete manner by reconstructions built up from serial sections. A single example has afforded nearly all the information which has been slowly accumulated from numerous specimens during the past half-century and has added the following facts, which are either new or were in need of confirmation:—(1) The vomer is grooved on its dorsal surface; (2) the basis cranii is continued forwards between the orbits as a median vertical plate, which lies in the groove of the vomer, and is itself grooved on the dorsal surface to receive the ventral edge of the mesethmoid; (3) the form of the mesethmoid is such as to suggest that it is an early stage in the formation of a cribriform plate; (4) septo-maxillary bones are present, lying within the internal nares without appearing on the face. They are not connected by suture with neighbouring bones and might easily be lost in fossilisation; (5) the preparietal bone is present, situated entirely in front of the pineal foramen and forming its anterior border; (6) a transverse bone exists, clearly marked off from the neighbouring bones by sutures; (7) the root of the tusk, invested by a thin layer of the maxillary bone, lies in a large cavity, to the walls of which the maxillary, lachrymal, jugal, and palatine bones contribute; (8) the sutures separating the pro-otic from neighbouring bones are clearly exhibited; (9) the labyrinth of the ear shows all the three canals with their ampullæ and a long vestibule; (10) the articular surface of the lower jaw is complex, there is a small inner portion which is concave—as in reptiles, and a large outer portion which is convex—as in mammals.—W. **Cramer** and R. A. **Krause**: Carbohydrate-metabolism in its relation to the thyroid gland. The effect of thyroid feeding on the glycogen content of the liver and on the nitrogen distribution in the urine.—Dr. G. W. C. **Kaye** and D. **Ewen**: The sublimation of metals at low pressures.—Dr. R. T. **Beatty**: The energy of Röntgen rays.—Dr. C. **Chree**: Some phenomena of sun-spots and of terrestrial magnetism. Part ii. The paper is a continuation of one termed for brevity S.M., which appeared in the Phil Trans., A. 212, p. 75. It is mainly devoted to the question of the existence of a period of approximately twenty-seven days in terrestrial magnetic phenomena. Independent studies of magnetic storms during a very long period of years at Greenwich and Toronto led Mr. Harvey and Mr. Maunder a good many years ago to the conclusion that an interval of about twenty-seven and a quarter days could be recognised between the commencements of successive magnetic storms in a greater number of cases than could reasonably be ascribed to pure chance. S.M. showed that whether one took the daily range of horizontal force at Kew, or the magnetic character of the day, there undoubtedly existed for the epoch 1890 to 1900 a period of twenty-seven days or slightly more, in the sense that if an individual day were highly or moderately disturbed, days twenty-seven or twenty-eight days later were on the average more disturbed than usual. The result was not peculiar to the large disturbances usually termed "magnetic storms," and appeared in all the years examined, whether quiet or disturbed. The present paper finds the same result to hold true of the years 1906 to 1911 when use is made of the magnetic "character" figures which have been published since 1906 at de Bilt, under international auspices. It is also found that the result is as true of quiet as of disturbed characteristics. The paper also investigates whether the phenomena presented by the twenty-seven-day period vary with the period of the year, and what the relationships are, if any, between magnetic "character" and Greenwich measures of sun-spot area and faculæ and Wolfer's sun-spot frequencies. The apparent sun-spot relationships are found to vary a good deal from year to year.—A. **Fowler**: New series of lines in the spark spectrum of magnesium. From experiments on the spectrum of the magnesium arc *in vacuo*, it has been found that there are seven lines which are associated with the well-known spark line 4481·35, their wave-lengths being 3104·91, 2661·00, 2449·68, 2329·68, 2253·94, 2202·75, and 2166·35. The eight lines, taken alternately, fall into two series having their common limit at 49776 on the frequency scale. The series are analogous to the two principal series of hydrogen lines, which have recently been investigated by the author. A. **Fowler** and W. H. **Reynolds**: Additional triplets and other series lines in the spectrum of magnesium. The paper gives particulars of eight new triplets which have been photographed in the ultra-violet spectrum of magnesium, and improved wave-lengths for some of the lines previously recorded. The Rydberg series of single lines has also been extended, and four strong solar lines of previously unknown origin have been identified with lines of this series. Attention is also directed to a probable second subordinate series of single lines. Formulæ representing the various series are given.—W. E. **Curtis**: A new band spectrum associated with helium. The paper describes a new band spectrum observed under certain conditions in vacuum tubes containing helium and hydrogen. The experiments suggest that the bands are due to helium, but until hydrogen can be more completely eliminated their origin cannot be regarded as definitely settled.—Sir W. de W. **Abney** and Dr. W. **Watson**: A case of abnormal trichromatic colour vision due to a shift in the spectrum of the green sensation curve.—Dr. E. F. **Armstrong** and Prof. H. E. **Armstrong**: Studies on the processes operative in solutions (XXX) and on enzyme action (XX). The nature of enzymes and of their action as hydrolytic agents.—Prof. H. E. **Armstrong** and H. W. **Gosney**: Studies of enzyme action. XXI. Lipase. III.—Prof J. S. **Macdonald**: Studies in the heat production associated with muscular work. Preliminary communication.—Prof. F. **Keeble**, Dr. E. F. **Armstrong**, and W. N. **Jones**: The formation of the Anthocyan pigments of plants. Part vi.—T. Graham **Brown**: The question of fractional activity ("All or None" phenomenon) in mammalian reflex phenomena.—J. H. **Andrew** and Dr. A. **Holt**: The thermal effects produced by heating and cooling palladium in hydrogen.—Hon. R. J. **Strutt**: A peculiar form of low potential discharge in the highest vacua.—A. **Mallock**: Note on copying machinery.—W. **Wahl**: The relation between the crystal-symmetry of the simpler organic compounds and their molecular constitution. Part ii.—G. A. **Shakespear**: Experiments on the temperature coefficient of a Kew collimator magnet.—W. **Jevons**: Spectroscopic investigations in connection with the active modification of nitrogen. III.: Spectra developed by the tetrachlorides of silicon and titanium.—Lord **Rayleigh**: The passage of waves through fine slits in thin opaque screens.—Prof. W. H. **Bragg**: The reflection of X-rays by crystals. II. In a previous communication (April, 1913) it was shown that the wave-lengths of homogeneous pencils of X-rays could be expressed accurately in terms of the space relations of a crystal. The formula $\lambda = 2d \sin \theta$ connected the wave-length λ with θ, the glancing angle at which the pencil was reflected in the crystal face, and d the distance between parallel reflecting planes. The angle θ could be determined with accuracy, but want of exact knowledge of crystal structure threw difficulties in the way of a complete evaluation of wave-length. W. L. Bragg, using two independent methods of research (those of the Laue diagram, and of reflection in the crystal face), has shown that in all probability the value of d is $2{\cdot}81 \times 10^{-8}$ cm. From this it follows that the wave-length of the "B peak" is $1{\cdot}10 \times 10^{-8}$. Characteristic radiations having wave-lengths $1{\cdot}25 \times 10^{-8}$ and $1{\cdot}66 \times 10^{-8}$ are emitted by bulbs having antikathodes of tungsten and nickel respectively. So far as it has been found possible to measure the absorption coefficients, they belong to rays which are characteristic of the antikathode metals, and the quantum energy—Planck's constant multiplied by frequency—agrees well with the energy of the kathode ray which, according to Whiddington, is required to excite the X-ray, or which the X-ray can excite.—W. L. **Bragg**: The structure of some crystals as indicated by their diffraction of X-rays. An analysis of the Laue diagram of sylvine (KCl) shows that the diffracting centres are arranged on a space-lattice of the simplest cubical form. The diagrams of potassium iodide and bromide show that the diffracting centres are arranged on a lattice the element of which is the face-centred cube. Sodium chloride is an intermediate case. From this and other features of the diagrams, it is concluded that in all these crystals the atoms of metal and halide are arranged in a simple cubic lattice, rows parallel to the axes containing alternate atoms of either kind. In sylvine the equal weights of the atoms render them equally efficient as centres; in KBr and KI the heavy halogen atoms alone act, and so the pattern is characteristic of the face-centred cube lattice. The diagrams of other crystals are discussed in reference to these conclusions. By means of the X-ray spectrometer, described in a previous paper, the dimensions of these lattices can be accurately compared; and the relative magnitudes of the different orders of spectra reflected from any face, and from different crystals, yield information which confirms the above conclusions. It also appears that the weight associated with each point of the lattice is proportional to the molecular weight of the substance. These conclusions yield the necessary information for the accurate calculation of the wave-length of the X-ray.—Leonard **Hill**, J. M. **McQueen**, and W. W. **Ingram**: The resonance of the tissues as a factor in the transmission of the pulse and in blood pressure.—G. F. **Davidson**: Experiments on the flow of viscous fluids through orifices.

Linnean Society, June 19.—Prof. E. B. Poulton, president, in the chair.—E. G. **Baker**: African species of the genus Crotalaria. Short descriptions are given of the 309 species known to the writer as occurring in Africa. These are arranged in the following groups:—Simplicifoliæ, 39; Sphærocarpæ, 65; Chrysocalycinæ, 7; Farctæ, 5; Spinosæ, 3; Eucrotalaria, subdivision Grandifloræ, 29; subdivision Mediocrifloræ, 61; subdivision Parifloræ, 49; subdivision Oliganthæ, 33; subdivision Stipulosæ, 18. The genus Crotalaria is allied to Lotononis, and it is generally easily distinguishable by the rostrate carina.—Dr. W. T. **Calman**: Aphareocaris, nom. nov. (Aphareus, Paulson), a genus of the Crustacean family Sergestidæ.—Dr. Agnes **Arber**: An anatomical study of the cone-genus Lepidostrobus.—G. H. **Wailes**: Freshwater Rhizopoda from North and South America. During the year 1912 gatherings from the States of New York, New Jersey, and Virginia provided records of twenty-four species and varieties of Rhizopoda, in addition to those enumerated in the paper read before the society in April, 1911. A number of gatherings received from Mr. James Murray and collected by him from various places on the east and west coasts of South America were examined, and provided records of seventy-five species and varieties of Rhizopoda, including three now described for the first time.—C. **Bucknall**: A revision of the genus Symphytum.—S. **Kemp**: Pelagic Crustacea Decapoda of the Percy Sladen Expedition in H.M.S. *Sealark*.

PARIS.

Academy of Sciences, June 30.—M. P. Appell in the chair.—Paul **Sabatier** and M. **Murat**: The preparation of several diphenylpentanes and some corresponding di*cyclo*hexylpentanes. Three of the eighteen possible isomeric diphenylpentanes have been prepared, and these have been transformed by direct addition of hydrogen in presence of nickel into the corresponding di*cyclo*hexylpentanes, the physical constants of the latter being given.—M. de **Forcrand**: The hydrates of uranic anhydride and the heat of formation of uranyl nitrate.—R. **Lépine** and M. **Boulud**: The diminution in chlorides in urine secreted under pressure. Additional experiments confirming results published in previous papers.—M. **Arnaud**: Astronomical refraction under any angle whatever. In a previous communication a formula for refraction was given and the integration solved for the particular case of horizontal refraction. In the present paper this is extended, and practical formulæ deduced giving an accuracy of $0 \cdot 1''$.—A. **Korn**: Integral equations with asymmetrical nucleus.—Ed. **Sarasin** and Th. **Tommasina**: A new study of the Volta effect made with the aid of the induced radio-activity.—Pierre **Weiss**: The magnetic fields obtained with an electromagnet furnished with ferro-cobalt pole-pieces. By the use of ferro-cobalt pole-pieces in place of soft iron an increase of about 5 per cent. in the strength of the magnetic field is obtained, the ampere turns remaining constant.—C. **Chéneveau**: The optical properties of water and its physical constitution. The variations in the optical constants of water with temperature are in agreement with the hypothesis that liquid water is a mixture of two isomers, in proportion varying with the temperature, and possessing properties depending only slightly or not at all on the temperature.—M. **Guéritot**: A thermo-electric manoscope of great sensibility. A portion of the air in a tube connecting two reservoirs is continuously heated near a bend constituting the highest point of the system. The slightest motion of this heated air is shown by a thermocouple; a displacement of gas amounting to only a tenth of a cubic millimetre is shown. Various applications of the apparatus are indicated.—Keivin **Burns**: A displacement of the lines of the spectra of certain metals produced by the presence of another metallic vapour. The cases of barium in an iron arc, manganese in an iron arc, and cadmium in a mercury arc have been studied, and it has been found that the lines of the metal present in small proportion are displaced by the vapour of the predominating metal (iron, mercury). This effect may account for some differences proved to exist between wave-lengths found in the arc and in the sun.—L. **Gay**: Adiabatic expansion in liquids. Data are given for the coefficient of adiabatic compressibility of eight liquids at 0° C. and at room temperatures.—Victor **Henri**: Chemical lability and absorption of the ultra-violet rays. Experimental results are cited in support of the proposition that bodies of which the molecules are labile, or which enter easily into reactions, absorb the ultra-violet rays strongly.—Witold **Broniewski**: The thermo-electricity of steel. It is shown that the thermo-electromotive force may give indications of the critical points of steels with equal or higher precision than the other methods in current use.—N. D. **Costeanu**: The action of carbon dioxide upon mineral sulphides. The sulphides of silver, copper, cadmium, bismuth, and antimony undergo no change when heated in a current of carbon dioxide; silicon sulphide gives carbon monoxide, sulphur, and silica under the same conditions.—P. **Lebeau** and A. **Damiens**: The composition of the gaseous mixtures resulting from the action of water upon the carbides of uranium and thorium. The method previously described by the authors for the analysis of complicated hydrocarbon mixtures, based on the use of low temperatures, has been applied to the analysis of the gases arising from the decomposition of uranium and thorium carbides by water. Five complete analyses are given.—Daniel **Berthelot** and Henry **Gaudechon**: The preparation of carbon oxycyanide. This substance is produced by the action of the silent discharge on a mixture of carbon monoxide and cyanogen.—André **Meyer**: The azoic colouring matters derived from phenylisoxazolone.—Léo **Vignon**: The composition of water-gas. A small proportion of methane appears to be normally present in water-gas; the amount of this gas is shown to increase with the amount of lime present in the coke.—J. **Clarens**: The existence of bromites. Evidence is adduced in support of the existence of a bromite in a solution of a hypobromite which has been heated for a short time to 80° C.—L. **Daniel** and J. **Delpon**: A grafted hybrid between the peach and the almond.—P. **Choux**: The genus Baseonema at Madagascar.—H. **Devaux**: The pressure of the air in the lacunæ of aquatic plants. The pressure of the internal atmosphere of an aquatic plant when submerged is equal to that of the dissolved gases.—M. **Wilmet**: The okapi. Study of an okapi kept in captivity for one month.—J. **Bounhiol**: New observations on the reproduction of the Algerian sardine.—H. **Bierry** and Mlle. Lucie **Fandard**: Variations of glycemia during inanition.—E. **Gley** and Alf. **Quinquaud**: The action of thyroid extract on the super-renal secretion.—R. **Robinson**: The genital glands and the dental system.—Albert **Robin**: Researches on the variations of phosphoric acid in the urine and liver of cancer subjects.—J. **Ville** and E. **Derrien**: Biochemical catalysis of a luminescent oxidation.—F. **Jadin** and A. **Astruc**: Arsenic and manganese in young and old leaves.—Pierre **Thomas**: The proteid substances of yeast. The albumenoid material derived from yeast is shown to be intermediate in properties between casein and egg albumen. It is provisionally named cerevisine.—Gabriel **Bertrand** and H. **Agulhon**: The presence of boron in milk and in eggs. The milk from four animals and eggs from five species of birds were proved to contain boron.—H. **Pottevin** and H. **Violle**: The comma bacillus and its toxins.—Alphonse **Berget**: A simplified barometric formula for the determination of heights. The formula proposed is $Z = D(t+269)/h$, in which Z is the difference of height, D the difference of pressures read on the barometer at the two stations, h the mean barometric pressure, and t the mean temperature. For heights below 3000 metres the agreement between this arithmetical formula and the usual logarithmic expression is shown by examples to be very close.

BOOKS RECEIVED.

Clinical Surgical Diagnosis for Students and Practitioners. By Prof. F. de Quervain. Translated by Dr. J. Snowman. Pp. xv+779. (London: J. Bale, Ltd.) 25*s*. net.

Report on the Progress of Agriculture in India for 1911–12. Pp. 65. (Calcutta: Superintendent Government Printing, India.)

Western Australia. Geological Survey. Bulletin No. 42. Contributions to the Study of the Geology and Ore Deposits of Kalgoorlie. E. Coolgardie Goldfield. Part i. By E. S. Simpson and C. G. Gibson. Pp. 198+49 plates+2 maps. (Perth, Western Australia: F. W. Simpson.)

Bureau des Longitudes. Conférence Internationale de l'Heure (Paris, Octobre, 1912). Pp. 282. (Paris: Gauthier-Villars.)

Mysore Government. Meteorological Department. Report on Rainfall Registration in Mysore for 1911. By N. V. Iyengar. Pp. xvi+49+plates. (Bangalore: Government Press.)

Canada. Department of Mines. Mines Branch. The Magnetic Iron Sands of Natashkwan, County of Sagvenay, Province of Quebec. By G. C. Mackenzie. Pp. vi+57+xxii plates+maps. (Ottawa: Government Printing Bureau.)

Annual Report on the Mineral Production of Canada. During the Calendar Year 1911. By J. McLeish. Pp. 316. (Ottawa: Government Printing Bureau.)

Meteorological Observations made at the Royal Observatory, Hong Kong, in the Year 1912. Pp. ii+114+2 plates. (Hong Kong: Noronha and Co.)

Bulletin of the Territory of Papua. No. 1, Notes on the Occurrence of Coal, Petroleum, and Copper in Papua. By J. E. Carne. Pp. viii+116+plates. (Sydney: W. A. Gullick.)

Resuscitation from Electric Shock, Traumatic Shock, Drowning, Asphyxiation from any Cause, by Means of Artificial Respiration by the Prone Pressure (Schaefer) Method. By Dr. C. A. Lauffer. Pp. v+47. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd.) 2*s.* net.

Researches in Physical Optics, with especial Reference to the Radiation of Electrons. By Prof. R. W. Wood. Part i. Pp. vii+134+10 plates. (New York: Columbia University Press.)

Graphical Methods. A Course of Lectures delivered in Columbia University, New York, October, 1909, to January, 1910. By Prof. C. Runge. Pp. vii+148. (New York: Columbia University Press.)

Coöperation in Agriculture. By G. H. Powell. Pp. xv+327+xvi plates. (London: Macmillan and Co., Ltd.) 6*s.* 6*d.* net.

The Farmer of To-morrow. By F. I. Anderson. Pp. ix+308. (London: Macmillan and Co., Ltd.) 6*s.* 6*d.* net.

Practical Stone Quarrying. By A. Greenwell and J. V. Elsden. Pp. xx+564. (London: Crosby Lockwood and Son.) 12*s.* 6*d.* net.

Ueber die neuen Bestrebungen, das Los der Krebskranken zu verbessern. By Dr. V. Czerny. Pp. 18. (Leipzig and Berlin: B. G. Teubner.) 60 pfennigs.

Entwurf einer verallgemeinerten Relativitätstheorie und einer Theorie der Gravitation. I., Physikalischer Teil. By A. Einstein. II., Mathematischer Teil. By M. Grossmann. Pp. 38. (Leipzig and Berlin: B. G. Teubner.) 1.20 marks.

Didaktik der Himmelskunde und der astronomischen Geographie. By Dr. A. Höfler and others. Pp. xii+414. (Leipzig and Berlin: B. G. Teubner.) 12 marks.

Trigonometry. Complete Tables. By Profs. A. M. Kenyon and L. Ingold. Edited by E. R. Hedrick. Pp. xi+132+xviii+124. (London: Macmillan and Co., Ltd.) 6*s.* net.

Trigonometry. Brief Tables. By Profs. A. M. Kenyon and L. Ingold. Edited by E. R. Hedrick. Pp. xi+132+xviii+12. (London: Macmillan and Co., Ltd.) 4*s.* 6*d.* net.

Logarithmic and Trigonometric Tables, prepared under the direction of E. R. Hedrick to accompany a Plane and Spherical Trigonometry. By Profs. A. M. Kenyon and L. Ingold. Pp. xviii+124. (London: Macmillan and Co., Ltd.) 2*s.* 6*d.* net.

The Seine from Havre to Paris. By Sir E. Thorpe. Pp. xxi+493+maps. (London: Macmillan and Co., Ltd.) 12*s.* 6*d.* net.

Mitteilungen aus den deutschen Schutzgebieten. Erganzungsheft Nr. 7:—Wissenschaftliche Ergebnisse einer amtlichen Forschungsreise nach dem Bismarck-Archipel im Jahre 1908. III., Untersuchungen über eine melanesische Wanderstrasse. By Dr. G. Friederici. Pp. iii+182. (Berlin: E. S. Mittler und Sohn.) 3.60 marks.

Wild Flower Preservation. By M. Coley. Pp. 191 +xxix plates. (London: T. Fisher Unwin.) 3*s.* 6*d.* net.

Report on the Danish Oceanographical Expeditions, 1908–10, to the Mediterranean and Adjacent Seas. No. 2. Vol. ii., Biology. Vol. iii., Miscellaneous Papers. By Dr. J. Schmidt. Pp. 150+iv plates+14 +iii plates. (Copenhagen: A. F. Host and Son.)

Studies on the Influence of Thermal Environment on the Circulation and the Body-Heat. By Dr. E. R. Lyth. Pp. vi+72. (London: John Bale, Ltd.) 2*s.* 6*d.* net.

Board of Agriculture and Fisheries. Annual Report of the Intelligence Division. Part i. Pp. 93. (London: H.M.S.O.; Wyman and Sons, Ltd.) 5*d.*

Hamburgische Sonnenfinsternis-Expedition, 1905. Totale Sonnenfinsternis, 1905, August 30. Photographische Aufnahmen der Sonnenkorona ausgeführt in Souk-Ahras (Algerien). By R. Schorr. 9 plates. (Hamburg: Hamburger Sternwarte, Bergedorf.)

Abwehrfermente des tierischen Organismus gegen körper-, blutplasma- und zellfremde Stoffe, ihr Nachweis und ihre diagnostische Bedeutung zur Prüfung der Funktion der einzelnen Organe. By E. Abderhalden. Second edition. Pp. xii+199. (Berlin: J. Springer.) 5.60 marks.

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P. HEBBLETHWAITE, M.A., Registrar.

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Applications are invited for the post of ASSISTANT LECTURER in MATHEMATICS. Salary £140.

Applications and testimonials should be received not later than Saturday, September 13, by the undersigned, from whom further particulars may be obtained.

JOHN EDWARD LLOYD, M.A.,
Secretary and Registrar.

July 11, 1913.

THURSDAY, JULY 17, 1913.

ARISTARCHUS OF SAMOS.

Aristarchus of Samos: The Ancient Copernicus. A History of Greek Astronomy to Aristarchus together with Aristarchus's Treatise on the Sizes and Distances of the Sun and Moon. A New Greek Text with Translation and Notes. By Sir Thomas Heath, K.C.B., F.R.S. Pp. viii+425. (Oxford: Clarendon Press, 1913.) Price 18*s*. net.

ARISTARCHUS, who flourished in the first half of the third century B.C., is chiefly known as the only philosopher or astronomer of antiquity who taught that the earth moves round the sun. This doctrine is, however, not mentioned in the only writing of his which has been preserved, and the little we know about it is derived from allusions to it made by subsequent writers. All the same, his little book, "On the Sizes and Distances of the Sun and Moon," is of great importance, and Sir Thomas Heath's new and critical edition, accompanied by a translation, commentary, and notes, is therefore a most welcome addition to the literature of astronomical history.

Considering that the idea of the earth being in the centre of the universe reigned undisturbed until less than four hundred years ago, it is one of the most surprising facts in the history of astronomy that its motion round the sun should have been proposed more than 1700 years before the time of Copernicus, and that it should only have been accepted by one single philosopher, Seleukus, as to whom it is not even certain that he went the whole way and did not merely accept the daily rotation of the earth. The editor of this new edition of Aristarchus, therefore, thought it desirable to prepare a lengthy introduction to the work, giving an account of the progress of astronomy in Greece from the time of Thales to and including that of Aristarchus. Though this is not the first time that an English writer has dealt with this subject, Sir Thomas Heath has done good work by preparing this introductory memoir, which fills more than three hundred pages, as he possesses special qualifications for writing the history of Greek science, and there are various controversial matters which cannot be too much discussed—provided it is done by writers who are as competent to do so as he is. The author gives full references to the very copious literature on the subject; indeed, he even notices some statements which he might well have ignored, such as the comically exaggerated picture drawn by Gomperz, of how Demokritus seems to have anticipated out of his inner consciousness many modern discoveries. The passages in the works of ancient writers from which our knowledge of early Greek astronomy is derived are always given at full length in translation, which many readers who may not have access to the originals will find very convenient.

The chapters on the pre-Socratic philosophers, the Pythagoreans, Plato, Eudoxus, and Aristotle, do not call for special notice. They deal very fully and fairly with all the questions about which a good deal of controversy raged fifty or sixty years ago, but which may now be considered finally settled. Nobody now believes that Plato taught the daily rotation of the earth, or that he, in his old age, was inclined to think that the sun was at the centre of the universe. The debatable question is now, how astronomy can have advanced so much during the sixty or seventy years after the promulgation of the system of concentric spheres of Eudoxus as to lead Aristarchus to announce that the earth moved round the sun in a year.

The dominating figure of this period (as regards the progress of astronomy) is not Aristotle, but Herakleides of Pontus. Of him we know with certainty that he taught the rotation of the earth and the motion of Mercury and Venus round the sun. But much greater honours were claimed for him by Schiaparelli, who, in a memoir published in 1898, tried to show that Herakleides not only must have extended his theory from the inferior to the superior planets, thus enunciating the Tychonic system, but that he must also have taken the next step in favour of the heliocentric system. He should thus have anticipated Aristarchus. The only alleged proof of this is a passage in a lost book by Geminus (who lived 250 years after Herakleides) quoted by Simplicius. That this very peculiarly worded passage is corrupt is beyond a doubt; Sir Thomas Heath shows clearly that the name of Herakleides occurring in it is a later interpolation, and he suggests that Geminus may simply have been alluding to the doctrine of Aristarchus. But in any case it is impossible to get over the express statement of Simplicius that Herakleides assumed the earth to be in the middle, while Aëtius (the compiler of the "Placita Philosophorum") distinctly says that Herakleides let the earth move, "not progressively, but in a turning manner." That is to say, it stood still, but it rotated on its axis.

There is therefore no reason to believe that Aristarchus had any predecessor in developing first the so-called system of movable excentrics, and then, by a bold step, the heliocentric system. That this met with no acceptance was doubtless due to the improved knowledge of the motions of the planets in the third century, when it was found that there were other irregularities which could not be accounted for by assuming the earth to be in motion.

The book of Aristarchus, now for the first time translated into English, is of great interest to the mathematician because the ratios of the sizes and distances which he calculates are really trigonometrical ratios, sines, cosines, &c., although at the time when the book was written trigonometry had not been invented, and no close approximation to the value of π was known. Aristarchus therefore endeavours to find upper and lower limits for those ratios by assuming propositions comparing the ratio between a greater and a smaller angle in a figure with the ratio between two straight lines in the figure. These propositions were afterwards proved by Ptolemy. To the astronomer the book is particularly interesting by the attempt made by Aristarchus to determine the ratio of the distances of sun and moon by observing their angular distance at the time when the moon was half illuminated. The very erroneous result found (19 : 1), corresponding to a solar parallax of 3′, continued to be accepted from the time of Ptolemy to that of Kepler.

J. L. E. D.

THE APOTHEOSIS OF THE POTATO.

(1) *The Potato: A Compilation of Information from Every Available Source.* By E. H. Grubb and W. S. Guilford. Pp. vii + 545. (London: Constable and Co., Ltd., 1913.) Price 8*s.* 6*d.* net.

(2) *Commercial Gardening: A Practical and Scientific Treatise for Market Gardeners, Market Growers, Fruit, Flower and Vegetable Growers, Nurserymen, &c.* By many practical Specialists, under the Editorship of John Weathers. In four volumes. Vol. i., pp. xiii + 239 + plates; vol. ii., pp. xii + 235 + plates; vol. iii., pp. xii + 240 + plates; vol. iv., pp. xii + 244 + plates. (London: The Gresham Publishing Co., 1913.) Price 36*s.* net, the four volumes.

(1) THERE are men who, having attained to wealth and fame by the agency of some humble instrument, basely repudiate and kick over the ladder by which they have risen. Not so the authors of the first book on our list. The potato has "made" them, and in return they proceed to "make" the potato. A large number of men have at times written about this vegetable, and extracts from their books and papers occupy a very large proportion of the volume. The food value, methods of propagating, cultivating, harvesting, and selling, all receive attention, but the authors are so evidently enthusiastic, and discourse so eloquently on the merits of their subject, that we are carried along with them, and forget that, after all, they are only talking about potatoes, and not about alpine plants or roses.

The book makes one realise, as nothing else we know has quite done, how manifold are the aspects from which a simple natural object can be regarded. Successive chapters give long quotations from the writings of chemists, botanists, zoologists, entomologists, mycologists, agriculturists, engineers, economists, legislators, business men, doctors, historians, geographers, all dealing with problems directly and closely connected with the potato. And the senior author shows us enough of his personality to let us see how entirely enthusiastic the plant-fancier may become over this plant. There is nothing critical about the book, and the student of science may not find much of direct value to him. Perhaps its main interest to the general reader is that it deals with one of the humblest products of the garden in the same enthusiastic and affectionate spirit as Dean Hole wrote about roses, or Farrar about "alpines."

(2) The four volumes on commercial gardening represent a somewhat ambitious attempt to put into one work the rather wide knowledge that the successful grower ought to have of crops, manures, markets, &c.; they are frankly intended for the commercial man only. Had they been confined to practical matters we should have found little fault with them, but the scope has been widened, and chapters on "science" have been inserted. It might be argued that sound science could not fail to be useful to the grower; on the other hand, it might also be argued that the busy grower has no time to concern himself with the reasons for things, but simply wants specific, trustworthy information on his problems. Either plan might have been adopted and justified. But we do not see any justification for the third plan that has been followed of putting in poor science. While a first-hand knowledge seems to have been expected of the writers on practical subjects, no such qualification seems to have been deemed necessary in the case of science. We are not referring, of course, to Mr. Massie's and Mr. Theobald's contributions, or to some of the botanical work, which is also good, but the large sections on science are in the main distinctly poor. Some of the errors are ludicrous, and could have been corrected by any good student at an agricultural college. The distinction between

aërobic and anaërobic decompositions proved entirely too much for the author:—

"Curiously enough, he says, "some scientists say that if air is admitted to the soil nitrogen is set free from the organic matter; and, on the other hand, if air is excluded, nitrogen is set free from the nitrates; and in both cases it is lost. These views would appear to be mutually destructive."

The chemist is still worse: when appealed to by growers to help in checking plant-diseases,

"the chemist, like a sensible man of business, immediately proceeded to compound his nostrums and to talk learnedly about the fungoid and other diseases, at the same time not forgetting to take the fees to recompense him for his learning and skill."

But perhaps the most severe treatment is reserved for Rothamsted.

"The cultivation seems to be of the poorest description; in fact, it can hardly be described as cultivation at all. . . . One can imagine the condition of the soil . . . it must be almost as hard as rock, and impervious to rain, air, or roots. . . . Farming on the Rothamsted principle would appear to be a very precarious business."

As all this occurs in a science section, first-hand information was apparently deemed superfluous; nevertheless, a visit to Rothamsted first of all might not have been a bad idea. After this we are quite prepared for the author's scheme for making the wheat crop yield a profit of more than 70*l*. per acre, instead of 4*l*. or less as at present. The experimental basis consists of a trial made at Ealing in 1910 with 400 seeds; the results are multiplied up till they can be expressed in terms of one acre; and this in turn is multiplied up till the author foresees that "thousands of men would be kept on the land at better wages, and our wheat crops would be increased enormously. Agriculturists would do well to consider the above figures before smiling too broadly at them." Unfortunately, agriculturists have had these paper schemes presented to them fairly often for at least 250 years past, and now they require facts. Enough has been said, however, to show the sort of "science" that is considered good enough for growers.

E. J. RUSSELL.

TEXT-BOOKS OF PHYSICS.

(1) *Experimental Mechanics and Physics.* By A. H. E. Norris. Pp. viii+176. (London: Mills and Boon, Ltd., n.d.) Price 1*s*. 6*d*.

(2) *Elementary Physical Optics.* By W. E. Cross. Pp. 312. (Oxford: Clarendon Press, 1913.) Price 3*s*. 6*d*.

(3) *Heat: A Manual for Technical and Industrial Students.* By J. A. Randall. Pp. xiv+331. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1913.) Price 6*s*. 6*d*. net.

(4) *A Synopsis of the Elementary Theory of Heat and Heat Engines.* By J. Case. Pp. iii+65. (Cambridge: W. Heffer and Sons, Ltd., 1913.) Price 2*s*. 6*d*. net.

(5) *Elementary Principles of Electricity and Magnetism for Students in Engineering.* By Dr. R. H. Hough and Dr. W. M. Boehm. Pp. vii+233. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 6*s*.

(6) *Transport de Force.* Calculs Techniques et Economiques des Lignes de Transport et de Distribution d'Energie Electrique. By C. Le Roy. Deuxième Partie. Pp. 143. (Paris: A Hermann et Fils, 1913.) Price 6 francs.

(7) *First Year Course in General Science: A Combined Text-book and Note-book.* By E. A. Gardiner. Pp. vi+113. (London: W. Heinemann, n.d.) Price 2*s*. 6*d*. net.

(1) THE title of this little book is rather misleading. The use of the word "physics" suggests that the contents of the book comprise the various branches of physics, and not merely—as is actually the case—heat and a meagre treatment of a few of the properties of matter. These subjects occupy only one quarter of the volume, the remainder being devoted to mechanics. The treatment is very simple and is suitable as an introductory course. In this respect the book will no doubt serve its purpose as efficiently as many others of its class, although it exhibits no noteworthy advances in the mode of presentation of the subject. The frequent change of type is rather an unfortunate feature, and some of the diagrams are very badly drawn, notably a cube used to represent the measurement of volume, the perspective of which is in exactly the wrong sense.

(2) This book has several very good points. The subject is treated in a straightforward and lucid manner. The author has endeavoured to develop the theory of optics upon both "ray" and "wave" bases simultaneously, and we think he has succeeded. There is much to be said for both methods of treatment, and neither should be ignored. As is natural in an elementary treatise, no very difficult problems are considered, but it is rather surprising to find practically no reference to diffraction and interference, especially as some stress is laid on the wave theory. There are many simple experiments in this connection which, far from confusing a junior student, would undoubtedly interest him. One of the most notable

features of the book is the series of diagrams, which are well drawn, and often a whole page is devoted to a single figure, with the result that a very clear representation is secured.

(3) One is inclined to think that too much is being done nowadays in the matter of adapting branches of study to the special needs of various classes of students. Text-books of physics, and presumably of other subjects also, are written from the point of view of subsequent work, and the result is often detrimental to the students themselves. It is scarcely possible to avoid a certain looseness of language and an inexactness of expression when the subject is submitted to the special mode of treatment in question. The present book is quite a good one in many ways, and no doubt contains a great deal of useful information with regard to heat and heat engines. It is good to find the subject introduced from the point of view of energy, although the discussion of the meaning of energy is evidently handicapped by the knowledge on the part of the author of the very limited training in mechanics possessed by the students for whom the book is written. To each chapter the author appends a summary in heavy type of the important conclusions therein, together with a number of problems based on the work. Apart from the limitations imposed by the mode of treatment referred to, this book is a straightforward and lucid presentation of the subject.

(4) This pamphlet is frankly published for "cramming" purposes. It is intended as a synopsis for students reading for the Mechanical Sciences Tripos, and especially for the "A" paper in Heat. In order to make this perfectly plain the author leads off with some forty lines of doggerel, which, if committed to memory, apparently ensures success in the examination. To those students who regard their study of physics from this point of view, the book will prove useful in proportion to what they remember of its contents; to the serious student it can scarcely be recommended. For so small a volume the table of "errata" is too long; indeed, it rather looks as though this handbook has been hurriedly prepared.

(5) There is room for doubt as to whether it is desirable in a book on electricity and magnetism to avoid almost entirely references to the physical, as distinct from the mathematical, side of the subject. This is the only fault we have to find with this treatise, which is otherwise quite excellent. And even this objection disappears if it can be guaranteed that the book will be read concurrently with attendance at experimental lectures and laboratory work. Most teachers find that students of physics experience much more difficulty with the mathematics it involves than with the experimental principles upon which it is based. To those students this book should prove a boon. Here they will find presented in logical order and in a simple manner an extensive series of deductions from, and applications of, the fundamental laws of electrostatics, magnetism, and electromagnetics. Numerous numerical examples are appended to the various chapters, and at the end of the book the more important formulæ developed in it are compiled in a list. The use of this list, of course, involves the adoption of a particular notation in the memory of the student, and this, perhaps, is a little inexpedient at a time like the present, when notation varies so much; but it is not easy to see how to overcome the difficulty.

(6) To those interested, both theoretically and practically, in the transmission of electrical power this volume should prove of great interest and use. The author has carried out a large number of calculations of the various electrical data required in this connection, with numerical examples. Graphical methods are frequently resorted to, and the treatment of the whole subject appears to be very complete.

(7) The chief objection to this type of book is that it is very liable to become very dirty in the hands of a slovenly boy, and very unsightly, owing to numerous corrections, when written up by a boy who, though clean, is not brilliant. The instructions for the experiments are given clearly and neatly, and it seems rather a pity to spoil their appearance. The course comprises three parts, arranged more or less in order of difficulty, and a considerable number of simple experiments in mechanics, heat, and the physical and chemical properties of water and air are dealt with. At the end of each lesson a number of questions, intended for homework, are set. Presumably the answers to these are to be recorded in a separate notebook. Why not the experimental results also?

OUR BOOKSHELF.

Vegetation of the Peak District. By Dr. C. E. Moss. Pp. x + 235 + plates. (Cambridge University Press, 1913.) Price 12*s*. net.

QUICKLY following on Elgee's "Eastern Moorlands of Yorkshire," we have Moss's book on the vegetation of the Peak district, especially in its relations to geology and the chemical nature of the soil. Faunistic relations, so ably discussed by Elgee, are not considered by Moss. As the author remarks, the Peak district has no definite geographical boundaries, but his maps of the plant formations include the area lying between Mossley and Penistone to the north, and, approximately, Congleton and Matlock to the south, embracing portions of five counties, and sources of several head-streams of the Mersey, Dee, Trent, and Yorkshire Ouse.

There are several elevations of a little more than 2000 feet, and a large proportion of the district consists of unenclosed moorland and grassland. The maps are coloured to show the plant formations of acidic peat, siliceous soil, calcareous soil, sandy soil, and of cultivated land. The plant formations are subdivided into associations. For example, the formation of acidic peat exhibits associations in which *Vaccinium Myrtillus*, *Eriophorum vaginatum*, *Calluna vulgaris* respectively dominate, and others in which two of these units are more or less equally dominant.

Following an introduction, dealing, among other things, with rainfall, temperature, and winds, are chapters on woodland, scrub, grassland, moorland, rocks and screes, marsh, and aquatic and cultivated land associations. Summaries of the plant communities (these include formations and associations) of the Peak district and of Britain conclude a most interesting book, the illustrations and maps of which are excellent. W. B. H.

Outlines of Stationery Testing. A Practical Manual. By H. A. Bromley. Pp. 74. (London: C. Griffin and Co., Ltd., 1913.) Price 2*s*. 6*d*. net.

THIS little manual deals chiefly with the technical examination of paper, though other articles of stationery are included in its scope. It avoids theoretical considerations, and gives in simple language concise instructions for the practical testing of paper, physically, microscopically, and chemically. Under the first heading come questions of colour, nature of the paper, surface or "finish," texture, opacity, ink-bearing properties, and strength. Short notes are supplied explaining these terms as applied to paper, and the methods of testing the properties indicated by them.

Few words are wasted in the chapter devoted to explaining the microscopic examination of paper. The author has managed to condense the description of the examination into five small pages, whilst another five are allotted to plates showing the microscopic characters of the principal fibres.

Under the head of chemical examination, directions are given for determining the nature and amount of the mineral matter used as "loading," and of the organic substances, such as gelatine, rosin, casein, and starch, employed in the "sizing" of paper. Methods are also propounded for discriminating the colouring ingredients and detecting chemically certain fibres and impurities. In all cases, the author claims, the chemical processes described are those which require the simplest possible apparatus. The characteristics of special kinds of paper are indicated briefly, and the book concludes with short sections on the testing of ink, gum, sealing-wax, and other miscellaneous articles included in the term "stationery." Within its limits—those of a collection of notes for use in practically examining stationery—the book will be found useful.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Pianoforte Touch.

I CAN fully endorse Dr. Heaviside's opinions as to the possibilities of the piano-player, and could only wish that there were some reasonable prospect of this instrument being used to save a great portion of the uninteresting drudgery of the usual school music-lesson. At the present time a considerable amount of school time is wasted in attempting to learn an instrument which is so difficult to play that few succeed in obtaining any satisfactory results. This system does not succeed in producing musicians any better than the ordinary school algebra lesson succeeds in producing mathematicians.

On the other hand, my recent experiments in connection with this "patent" control have led me carefully to test the existing commercial piano-players, and I can fully endorse Mr. Wheatley's complaints as to their lack of responsiveness and their persistent assertion of their mechanical individuality in opposition to the most strenuous efforts of the performer controlling them. The methods of varying expression by means of punch-holes, or by damping down all the notes on one side or other of a hard and fast dividing line, produce a very pleasing impression at first, but one soon tires of their very limited capabilities.

In these circumstances I would strongly recommend Mr. Wheatley and any other readers of NATURE who are interested in the subject to experiment with the methods of control claimed in my patent specifications. Even a rough and ready device rigged up with sticks, strings, and kitchen weights produces such a great improvement in the range of effects and flexibility of the instrument that after experimenting with such an arrangement I found it impossible to obtain any satisfaction without it. I think it may be safely said that the mechanical self-assertiveness of the instrument can be reduced to a small quantity of the second order, and can be further reduced by a method of successive approximation. So soon as dynamical considerations are introduced the possibility of accenting notes in *chords* (*i.e. proper chords*, not the miserable arpeggios which are so often substituted for them in recently cut music rolls) becomes evident, and the production of variations of tone quality by differences of touch is probably much easier when effected this way than when the keys are played by hand. All this appears less difficult to learn than the control of the speed regulator, which must always remain a difficulty.

The absence of these capabilities constitutes the great defect of the commercial player. But the ordinary "practical man" cannot understand anything based on the principles of dynamics and physics, consequently he treats the pressure as if it were constant instead of a very variable function of the time, and the result is an instrument which is mechanical and little else, and can only be played with an unnecessary expenditure of energy.

I have heard a professional pianist perform a very delicate *pianissimo* passage in which the accented notes rang out clearly and brilliantly above the background without being played any louder. It was simply a difference of tone quality produced by a corresponding difference of touch. My dynamically-controlled piano-player is quite capable of giving a very approximate reproduction of this effect, whereas I have heard an expert break down hopelessly over a similar passage at an exhibition recital of a commercial machine.

With regard to the connection between tone quality and touch, I do not think Dr. F. J. Allen's explanation meets the case. Unless there is distinct experimental evidence to the contrary, I do not think we ought to exclude the *possibility* of a double or multiple impact between the hammer and string; indeed, some of my experiences favour this hypothesis. But I am inclining more and more to the belief that the differences may be largely due to the elasticity and inertia of the stem of the hammer. The introduction of these elements converts the hammer into a dynamical system capable of independent vibration. The method of normal coordinates then enables us to represent this system by a simpler system having the same vibration periods; for example, a system of two or more particles connected by elastic springs and moving in a straight line. It is clear that the duration of contact of a pair of such particles with the wire will depend largely on the state of compression between them and their relative velocity at the instant of impact. The interval between the release of the hammer and its striking the wire is probably short compared with the time of a free oscillation of the hammer itself, and certainly short compared with the time in which such an oscillation would die out. On setting the hammers of the horizontal piano low down, the variations of tone quality entirely disappear, as one would expect.

I find another favourable condition by developing Kaufmann's method in connection with the problem of a single inelastic particle striking a wire near one end. The duration of contact is determined by the vanishing of a function which has one or more minimum values before it actually vanishes, some of these being small. A very small difference in the assumed conditions might therefore convert one of these minimum values into a negative value. Remembering that such assumed conditions are probably not even approximately satisfied in practice, we still have a result indicating that the pianoforte hammer and string may be highly susceptible to any cause which tends to vary their duration of contact.

I am specially pleased to receive Dr. Heaviside's views on this subject, and to find that he has been long interested in these difficult problems.

Since writing this I have read Prof. Morton's letter, and am very glad to receive his references to previous work on the subject. With regard to his own experiments, I think something more is necessary for my purpose than what he mentions in NATURE, namely a comparison of the striking velocities of pianoforte hammers in *different* parts of the scale. I notice Prof. Morton does not mention what particular notes were struck in his observations. It would also be important to compare the striking velocities for two notes, one in the treble and one in the bass, when simultaneously excited by a common pneumatic impulse of long or short duration, such as can be produced in these piano-player experiments with properly cut chords. With regard to the other question, I think it is unfortunate that authors like Matthay have used the terms "good" and "bad" touch in this connection. I freely admit that the heavy, inelastic impacts produced by the inexperienced performer produce such a harsh effect as to be very objectionable (and possibly this may be due to Dr. Allen's so-called "xylophone" effect); on the other hand, any playing sounds to me mechanical which does not involve considerable variation of tone quality. This appears to me to be particularly necessary in studying piano arrangements of orchestral music, where the sharp, metallic tones of the brass instruments have to be brought out in contrast to the softer tones of the strings. Possibly when fingers are used the pianist usually has too many other matters requiring his attention. But whether a metallic effect is "good" or "bad" must depend on how and when it is used, and personally I should think a constant tone quality the worst effect of all. Prof. Morton's letter, however, raises a number of other questions which would take a long time to answer, and may have to be explained in subsequent correspondence.

G. H. BRYAN.

Plâs Gwyn, Bangor, North Wales.

Mackerel and Calanus.

WE all believe that most of our common food-fishes at some stage of life feed upon plankton, but those who have looked into sea-fisheries questions know that there is a great want of actual observations connecting the occurrence of some planktonic organism in quantity with the presence of a particular fish. Consequently the following record may be of interest to both marine biologists and fisheries experts.

We are out on a scientific fisheries cruise, and in addition to members of my own family, two well-known naturalists, Prof. Newstead and Mr. Alfred O. Walker are with us on the yacht, and we have just had what we regard as a satisfactory demonstration of the connection between a large shoal of mackerel and the occurrence of *Calanus finmarchicus* in unusual quantity.

On arriving in this bay last night we found that the local boats had been catching abundance of mackerel close to. We bought some for supper (good fish for a halfpenny each), and on dissection found that the stomachs of all of them were crammed full of fresh-looking Calanus (the individual Copepods being for the most part distinct and perfect), along with a few immature Nyctiphanes and larval Decapods. Prof. Newstead and my daughter then noticed, while fishing over the side of the yacht, about 8 p.m., that the gulls in the bay were feeding in groups around patches of agitated water evidently caused by shoals of fish. On rowing out to these we saw distinctly the mackerel, large and small, darting about in great numbers in the clear water, and we also noticed every here and there on the smooth surface of the water—it was a beautifully calm evening—innumerable small whirls or circular marks which, on looking closely, I found to be caused by large Copepoda close to the surface.

About twenty years ago I sent a note to NATURE, from the yacht *Argo*, in regard to large Copepoda (I think it was Anomalocera on that occasion, and the locality was further north, off Skye) splashing on the surface so as to give the appearance of fine rain; and this present occurrence at once reminded me of the former occasion, but here the Copepod was *Calanus finmarchicus* of large size and in extraordinary abundance. They could be clearly seen with the eye on leaning over the side of the boat, a small glass collecting jar dipped at random into the water brought out twenty to thirty specimens at each dip, and a coarse grit-gauge tow-net of about 34 cm. in diameter caught about 20 cubic centimetres of the Copepoda in five minutes. The mackerel were obviously darting about, occasionally leaping to the surface (which gave the gulls their opportunity) where the whirls caused by the Copepoda were thickest, and an examination of the stomach-contents of the fish on the yacht afterwards showed us that the amount in one mackerel was about the same quantity as that caught by the tow-net in five minutes. Prof. Newstead and I have made a count of 8 c.c. of the tow-net gathering, and estimate that it contains about 2400 specimens of

Calanus. This would give about 6000 Copepods in the stomach of an average mackerel, or in a five minutes' haul of the tow-net, on this occasion.

It may be added that these mackerel were evidently not being nourished in accordance with the views of Pütter, and were clearly able to fill their stomachs from the plankton around them.

W. A. Herdman.

S.y. *Runa*, Tobermory, N.B., July 12.

Helium and Neon.

The experiments communicated to the Chemical Society recently by Prof. Collie and Mr. Patterson, the lectures delivered by Sir J. J. Thomson, and the discussions which have taken place in Nature, on the possible synthesis of the chemical elements have aroused great interest outside England. So far as I can ascertain, opinion is much divided. For my own part I may perhaps be permitted to say that I have always entertained the idea of a possible formation of elements of the helium group from other gases by *integration*, just as these are formed from other elements by disintegration (see *Chemical News*, 1896, and *Berichte*, 1899). When I put forward this view objection was taken that 4H is greater than He, 4·032 instead of 3·99, and the same kind of objection may be raised to-day that He+O, or 3·9+16, is less than Ne, 20·2 (unless Ne is a mixture of gases).

In order that the above question might be solved definitely, I would beg to suggest that experiments should be conducted in Röntgen-tubes from the electrodes of which every trace of the gases "occluded" or firmly held by them would be first removed by continued bombardment with kathode rays.

As regards the question put forward by Sir J. J. Thomson, whether the new gas X_3, discovered by him, may be a new element that fills the vacant space in VII. group, 1 series (VII–1), in Mendeléeff's periodic system, I may be allowed to remark that Mendeléeff's prediction of the properties of the elements Sc, Ga, Ge, could be successful, because it was an *interpolation*; whereas the prediction of the properties of the element X=3 includes an *extrapolation*, which is always rather uncertain; besides, the gases of the helium group were unknown at the time of the prediction. Its properties may be derived from the following equations:—(1) Ne : F=He : X; (2) Li : F=H : X; (3) Li : H=F : X; but also (4) Fe : He=Mn : X, and (5) Cu : H=Br : X, showing how uncertain the prediction of its properties becomes, so that it is indeed probable that it will be more negative than fluorine, but not necessary that the gas should combine with the silicon of the glass.

The delicacy of Sir J. J. Thomson's new method has superseded our old methods of investigation in a way similar to that based upon radio-activity, and the results of the study of the new gases discovered by this new method are awaited by chemists with the greatest interest.

Bohuslav Brauner.

Bohemian University, Prague, July 6.

Red Water and Brine Shrimps.

By the kindness of Mr. A. W. Sheppard and Prof. A. Dendy, F.R.S., I have been enabled to examine specimens of the brine shrimps from Geelong mentioned by Mr. Whitteron in his letter (Nature, June 12, p. 372). They belong to the species *Parartemia zietziana*, described by the late Mr. O. A. Sayce in 1903 (Proc. Roy. Soc. Victoria, xv., part ii., p. 232). In Parartemia the unpaired uterine sac is produced into two large dorso-lateral lobes lying on either side of the "tail," and appearing, as Mr. Whitteron says, "like the egg sacs of Cyclops." Mr. Sayce's specimens were obtained from a "brackish-water swamp near Lake Alexandrina, South Australia." It is interesting to learn that the species is able also to live in the brine of salt-pans.

The flagellate described by Mr. Whitteron is probably allied to, and perhaps identical with, *Dunaliella salina*, which has long been known to cause a red coloration in the brine of salt-pans in Europe and Algeria. A detailed account of this form and references to the somewhat extensive earlier literature of the subject are given by Clara Hamburger ("Zur Kenntnis der *Dunaliella salina*," *Arch. Protistenk.*, vi., 1905, p. 111).

W. T. Calman.

British Museum (Natural History),
Cromwell Road, London, S.W., July 12.

The Maximum Density of Water.

Physiographers lead us to believe that the earth is defended from a profound glaciation, cumulative from year to year, by the law that water is heaviest at a temperature of four degrees above centigrade zero. If the main cause lies here, it is desirable that this measure should have its peculiar power set forth with more precision than has been customary.

The matter usually presents itself to students rather differently. The predominant fact is the floating power of ice. Hereby the water is screened from further attacks of the cold air, and dispersal is provided in the puzzling conditions of ground or anchor ice. Next perhaps in importance is the slow conduction of cold by water. Then comes the large value of the latent heat of water. It is not obvious why there should be disastrous results if the maximum density of water were at 0° C. The four units may be viewed as a helpful margin of safety rather than as an essential; but they would appear to be negligible in comparison with the 79 units of latent heat. Water at 0° C. is by no means unstable; each gram weight as it passes into ice throws out amongst its neighbours an amount of heat which is an effective safeguard against sudden and extensive solidifying.

W. B. Croft.

The College, Winchester, July 5.

Radio-activity and the Age of the Earth.

I am gratified to learn from Dr. Fermor's letter in Nature for July 10 that there is a scientific possibility of conceiving how the interior of the earth may be devoid of radio-activity. But if "high pressure and temperature" can inhibit the dissociation of "potentially radio-active" substances, will they not do so also in the interior of the stars? If so, radio-activity will no longer be available to prolong their radiation of energy, and we shall be back in the old difficulty about the age of the sun. Indeed, it will be aggravated, because we now have positive evidence for a high antiquity of the earth, while still unable to explain that of the sun.

F. C. S. Schiller.

Corpus Christi College, Oxford, July 11.

THE GENERAL MAGNETIC FIELD OF THE SUN.[1]

Those who are familiar with Prof. Hale's brilliant discovery of magnetic fields in sunspots, and are aware of the difficulties connected with that investigation, will greatly admire his courage in seeking to establish the much weaker general magnetic field of the sun itself. The following condensed account of the method adopted and results obtained is given, to some

[1] Based upon an advance proof of a paper by Prof. G. E. Hale which is to appear in *The Astrophysical Journal*.

extent, in Prof. Hale's own words. As a general problem of physics, Schuster's suggestion that every rapidly rotating body may produce a magnetic field is of fundamental importance. A direct test by laboratory experiments cannot be made because of the limitations of size and rotational velocity, but advantage may be taken of the heavenly bodies where these limitations do not obtain. The most promising object for such an investigation is the sun. It is here that the direct method of determining the magnetic field by observation of the Zeeman effect is most readily employed, since the sun is bright enough to permit the use of the very high dispersion required. Further, it is possible to observe at a great number of points on the surface, and since observations may be made in both hemispheres the most perfect test of the Zeeman effect can be applied by looking for a reversal of the sign of the displacement with the polarity. The present minimum of solar activity has furnished a particularly favourable opportunity for the investigation, in consequence of the general absence of local strong fields due to spots and other disturbances.

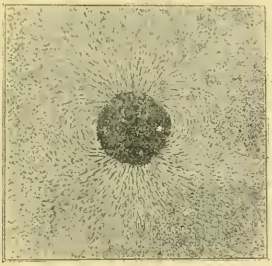

FIG. 1.—Lines of force of a magnetised sphere.

Assuming the sun's magnetic field to be similar to that of a magnetised sphere, with magnetic poles coincident with the poles of rotation, the lines of force would appear as in Fig. 1, the angle δ between them and the solar surface being given by $\tan \delta = 2 \tan \phi$, where ϕ is the heliocentric latitude. If the field were strong enough, and if the observer could look along the sun's axis and form an image of one of the poles on the slit of a spectroscope, certain solar lines would appear as doublets with components circularly polarised in opposite directions. If a Nicol prism were placed in front of the slit, with its long axis parallel to the slit, in combination with a quarter-wave plate set with its principal section at an angle of 45°, one of the components would be extinguished, while the other would be transmitted by the Nicol. Assuming the red component to be transmitted, a rotation of the quarter-wave plate through 90° would cause this to be extinguished and the violet component to be transmitted. If from the same place of observation the slit were directed to a point in 45° lat., the effect would still be clearly observable, though the transformation of the circularly polarised light of the components into elliptically polarised light would result in less complete extinction by the Nicol.

In the actual case the terrestrial observer is close to the plane of the sun's equator and must look in a direction nearly at right angles to the lines of force at the sun's poles.[2] He therefore cannot take full advantage of the fact that the total intensity of the sun's magnetisation is twice as great at the poles as at the equator. The angle between the lines of force and the line of sight, however, is reduced to zero at 35° north and south latitude; but the most favourable position for observation is 45° lat., where the effect of the ellipticity of the light is overcome by increased strength of the field.

On account of the weakness of the sun's magnetic field, complete separation into doublets is not to be expected, and the investigation must, therefore, depend upon the possibility of detecting very slight displacements of lines to red or violet, according to the position of the quarter-wave plate, with reversal of the sign of the displacements in passing from the northern to the southern hemisphere.

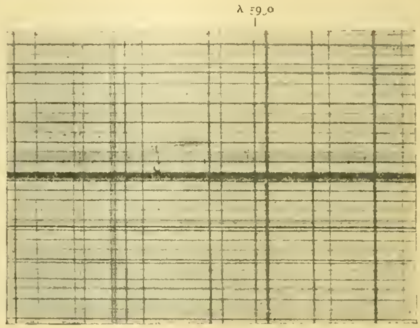

FIG. 2.—Region of λ5930 photographed in the third order with the 75-ft. spectrograph showing the division of the spectrum into 2 mm. strips by the compound quarter-wave plate. The heavy horizontal line marks the junction of two sections of the Nicol. The fifth stripe below is the "marked strip" used for reference purposes.

The first attempts to detect the solar magnetic field were made in 1908 with the 60-ft. tower telescope at Mt. Wilson, but it was not until the new 164-ft. tower telescope and 75-ft. spectrograph became available, in 1912, that definite results were obtained. With the latter instrument the sun's image is about 16 in. in diameter, and about λ5900 in the third order spectrum, where much of the work was done, the linear dispersion is 1 Ångström = 4·9 mm.; on this scale the distance between the D lines is 29 mm. For determination of focus and investigation of resolving power the extremely fine lines in the absorption spectrum of iodine were employed with advantage, and lines as close as 0·025 A.U. were found to be just resolved.

The polarising apparatus consists of a Nicol prism 18 mm. wide, built up of four sections, each 32·5 mm. long, so as to give a total length of 130 mm. The impossibility of rotating it is easily

[2] The triplets produced by light from the poles would, of course, be too narrow for observation as such, and the use of a Nicol in different positions would not affect the symmetry of the lines.

overcome by the use of a half-wave plate, as a rotation of this through a given angle is equivalent to a rotation of the Nicol through twice the angle.

The quarter-wave plate was built up of strips of mica, 2 mm. wide, mounted so that the principal sections of successive strips make an angle of 45° with the slit and 90° with each other; the Nicol would thus transmit, say, the red components of the doublets for the odd strips and the violet components for the even strips. In a photograph of the spectrum the lines would thus have a dentated appearance (Fig. 2), the magnitude of the separation of the components shown in successive strips varying directly with the strength of the field.

Every conceivable precaution appears to have been taken in setting the desired portion of the sun's image on the slit of the spectrograph, and in securing full illumination of the grating in any exposure. A valuable check on the observations was obtained by making duplicate exposures with the quarter-wave plate in the normal and inverted positions, which should give displacements of opposite sign if they are caused by a magnetic field. As a further check, at least one atmospheric line was measured on most of the plates of the first series, but afterwards they were only occasionally measured, as they were invariably found to give no shifts exceeding the errors of measurement. Possible effects of polarisation produced in the spectrograph have also been carefully considered.

The region of the spectrum selected, λ5800 to λ6000, was determined by the consideration that the magnetic separation varies directly as the square of the wave-length; too great a wave-length, however, being undesirable since the average sharpness of the solar lines decreases as the wave-length increases. Numerous difficulties arising from distortion of the cœlostat mirrors of the tower telescope and other causes were successfully overcome, and 280 photographs were obtained. For purposes of discussion the photographs and measures have been divided into four series.

For the preliminary observations it was decided to obtain a large number of measures of a few lines rather than a smaller number of measures of many lines. Three lines, showing the largest displacements, were accordingly selected for systematic investigation, namely, λ5812·139 (Fe,0), λ5828·097 (–,0), λ5929·898 (Fe,2).

The measurement of the minute displacements, amounting only to a few thousandths of a millimetre, presented great difficulties, largely arising from the natural diffuseness of the solar lines. Full details of the individual measures are given in the paper, and discordances appear to have been as faithfully recorded as the measures on which the final conclusions are based.

The tables and curves show a marked grouping of positive displacements in the northern and of negative displacements in the southern hemisphere, with values decreasing, on the average, from middle latitudes towards the equator or poles. It is also shown that the displacements were reversed in direction by turning the half-wave plate through 45° (equivalent to a rotation of the Nicol through 90°), or by inversion of the compound quarter-wave plate. Hence it is concluded that the light from the red and violet sides of the solar lines in question is circularly or elliptically polarised in opposite directions. In the northern hemisphere the light of the violet component is circularly polarised in the right-handed direction.

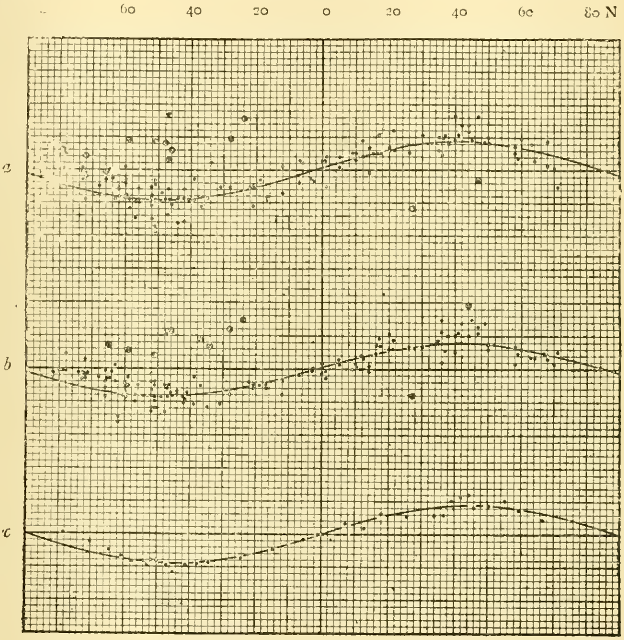

FIG. 3.—Displacements observed in different latitudes, fourth series. a, λ5812; b, λ5828; c, Mean curve of displacements including λ5930 from first and third series and λλ5812 and 5828 from fourth series. Vertical Scale: 1 division=0·001 mm.

Some of the evidence for the systematic shifts is reproduced in the appended table, giving the mean displacements for λ5930 in the first and third series, and λλ5812 and 5828 in the fourth series, as measured by Mr. Van Maanen:—

Lat.	Δ (unit= 0·001 mm.)	No. of observations	Lat.	Δ (unit= 0·001 mm.)	No. of observations
N. 68·8°	+2·2	15	S. 5·1°	-0·8	15
59·4	+3·6	15	14·3	-2·4	15
55·4	+5·1	16	24·2	-3·6	15
50·3	+4·4	15	34·1	-4·3	15
46·1	+4·1	15	37·7	-4·6	15
44·5	+6·0	15	41·0	-4·7	15
41·9	+5·7	15	45·1	-5·8	16
39·3	+5·1	15	47·1	-4·7	15
36·7	+3·0	15	49·9	-4·1	15
33·9	+2·9	15	51·7	-4·1	15
25·7	+2·7	15	52·8	-4·7	15
18·0	+3·1	16	57·3	-4·1	15
12·7	+0·8	15	60·5	-3·5	15
7·3	+1·6	15	64·5	-2·5	15
0·5	0·0	15	70·0	-1·1	15
			78·1	+0·1	15

A graphical representation of the results of this series of measures is given in Fig. 3, in which the horizontal scale is that of solar latitude, and the vertical scale that of displacements. The agreement of the data of the foregoing table with the theoretical curve derived from the average of the ordinates at 45° is shown in Fig. 3*c*.

It is considered that within the limits of precision the observations agree satisfactorily with the displacements calculated for lines originating in a source on the surface of a magnetised sphere, and observed from a point in or near the plane of the equator. On the assumption that the field is due to the rotation of a charged body, or of a body composed of neutral molecules which act as though they carried a charge, it is concluded that the sign of the dominant solar charge is negative, and that the north magnetic pole of the sun lies at or near the north pole of rotation.

The determination of the strength of the sun's field has presented some difficulty because the lines measured are so weak in the arc or spark that their separations in a magnetic field can only be determined experimentally with the greatest difficulty, or not at all. In the case of 5929·898, the procedure has been to observe the separation of the line in a sun-spot the strength of field of which was determined from other lines; as indicated by this line, the field strength of the sun at its pole is 28 gausses. The line 5812 and a nickel line 5831·821 (not yet fully discussed), by comparison with laboratory observations, lead to the values 48 and 29 gausses, but for comparison with the foregoing determination these should be increased by about 60 per cent. on account of systematic differences between the measurers. The general result is to indicate that the field strength at the sun's pole is of the order of 50 gausses. Various higher level lines, which show large Zeeman effects in the laboratory, have hitherto failed to show the effect of the sun's field, and it is therefore concluded that the intensity of the general field falls off very rapidly in passing upward through the reversing layer, more rapidly than in the case of spots.

Prof. Hale gives a careful discussion of the question as to whether the magnetic fields indicated by the observations are due to local phenomena or to the magnetic effect of a rotating sphere. In the case of spots, the Zeeman effect frequently extends beyond the penumbra, and the structure of the Hα flocculi sometimes suggests that local magnetic fields may also be caused by invisible spots, or by whirls in which no umbræ or penumbræ have appeared. There is also some evidence that the pores which occur in all parts of the sun may be small vortices which develop into spots under favourable conditions. Reasons are given for believing that the line displacements in question are not due to any of these causes. Right and left-handed whirls about spots are equally common in the northern and southern hemispheres, and there is no reason to suppose that they could produce the systematic displacements, of opposite sign in the two hemispheres, which have been observed. In fact, in the majority of the observations no spots whatever and very few calcium flocculi were visible on the sun. If the pores are electric vortices, like the spots, there is no reason to suppose that pores of one polarity preponderate in the northern hemisphere and those of opposite polarity in the southern, unless local differences in rotational velocity are sufficient to account for such small vortices as the pores may represent; this possibility, says Prof. Hale, deserves more careful consideration than he has yet been able to give it, but even if there were a clear preponderance of pores of opposite sign north and south, it would be difficult to account for the curve of observed displacements.

Serious objections having been urged against all theories of terrestrial magnetism, it can scarcely be hoped that any one of them can be applied without modification to the sun, especially in view of its high temperature, low density, and gaseous condition. In the case of spots, neutral molecules cannot produce the observed fields unless an improbable degree of separation of the positive and negative electrons is assumed. Harker's experiments,[3] however, have led Prof. Hale to suppose that in a spot there must be a flow of negative electrons from surrounding regions into the cooler umbra, and that the whirling of these in the vortex may account for the strong magnetic fields observed.

An extension of Dr. Harker's work made at Pasadena by Mr. King has further shown that although the ionisation current decreases as the pressure increases, it is still appreciable at pressures up to twenty atmospheres. On account of the greater mobility of the negative electrons, their tendency to flow towards regions of lower temperature, and the evidence afforded by Mr. King's experiments that solar ionisation is not limited to the region above the photosphere, it is evident that the electrical and magnetic phenomena of the interior of the sun must differ radically from those of the earth. But since the negative electrons will tend, on the average, to lie farther from the

[3] NATURE, July 18, 1912, p. 517.

sun's centre than the positive, the polarity of any general field that may thus result from the solar rotation should correspond with that of the earth's field.

There is reason to believe that in the solar atmosphere the negative electrons lie farther from the photosphere, on the average, than the positive electrons. The rotation of the atmosphere with the sun would thus tend to set up a magnetic field of the same polarity as that of the earth. At the base of the atmosphere this field would oppose the field due to the rotation of the body of the sun. Hence, assuming a suitable distribution of the positive and negative electrons, it may be possible to account in this way for the observed decrease in the strength of the general field at increasing distances from the photosphere. Prof. Hale thinks that it may even turn out that the Zeeman effect observed is due to the rotation of the solar atmosphere, and not to the rotation of the body of the sun.

Further work will be necessary before such questions as these can be fully discussed, and an extended series of observations, including lines representing a wide range of level, is contemplated.

The space at our disposal is too restricted to permit full justice to be done to this fine piece of work. It will be sufficiently evident, however, that Prof Hale has conducted the investigation with his accustomed skill and with due regard to the numerous possible sources of error.

THE BIRMINGHAM MEETING OF THE BRITISH ASSOCIATION.

THE arrangements for the Birmingham meeting (September 10–17) are almost completed. In order to avoid the competition for places at the various functions, which so often causes inconvenience to visitors, the local secretaries intend to obtain beforehand from members an indication of their wishes with regard to the general meetings, lectures, entertainments, and excursions; and a circular for that purpose will be issued shortly.

A new arrangement has been made for the convenience of the delegates of corresponding societies. Thanks to the council of the Birmingham Natural History and Philosophical Society, the meeting-room and library at 55 Newhall Street is to be placed at the disposal of the delegates for the display of their publications, and also to act as a meeting-ground for the representatives of these corresponding societies during the meeting. The addresses to the delegates will be given in the Technical School, Suffolk Street.

The lectures to citizens, which were inaugurated at Dundee last year, will be given on a more extended scale this year at the Digbeth Institute, Birmingham. Five lectures have been arranged by the council of the association. The first of these—"The Decorative Art of Savages"—will be given by Dr. A. C. Haddon, F.R.S., on Thursday, September 11, at 8 p.m. Other lectures will be "The Panama Canal," by Dr. Vaughan Cornish; "Heredity in relation to Man," by Dr. Leonard Doncaster; "The Microscopic Structure of Metals," by Dr. W. Rosenhain; "Radio-activity," by Dr. F. Soddy, F.R.S. These lectures are arranged for that section of the public which is interested in the progress of science, but cannot take part in the meetings of the association. They are not intended for members or associates. The chief points in the programmes of the sections are described below.

Section A (Mathematical and Physical Science).—The section meets this year under the presidency of Dr. H. F. Baker. It is expected that greater interest will be taken in the proceedings of the pure mathematics subsection than in former years. There is a possibility of a discussion on non-Euclidean geometry, which will be of interest to many in addition to the pure mathematicians. In the full section the chief item after the presidential address is a discussion on radiation, arranged for the Friday morning, which will be opened by Mr. J. H. Jeans. Profs. H. A. Lorentz and E. Pringsheim have accepted invitations to be present at the meeting, and will add greatly to the interest and value of this discussion. Prof. Planck may also possibly be there. Of the English scientific men who will be there, Profs. Love and Rutherford will take part in the discussion. Two other discussions have been arranged in conjunction with other sections. With the Engineering Section a joint meeting will be held at which reports of a committee which has been investigating problems of stress distribution will be discussed. The other meeting is with the Geography Section, at which problems of geodesy and mathematical geography will be considered. One paper of great interest to many will be presented by Capt. H. Winterbotham, on the accuracy of the principal triangulation of Great Britain.

Amongst the papers to be contributed to the section, one, by Prof. Barkla, on the nature of X-rays, will be of considerable interest, and will probably give rise to an animated discussion. This paper will probably be read in full section immediately after the presidential address at eleven o'clock on Thursday morning.

The meeting will be of special interest because of the close association of the president of the association, Sir Oliver Lodge, with the section. It is expected that a large number of leading English scientific men will be present, and already the published list of papers shows that a stimulating session may be expected.

Section B (Chemistry).—The programme of this section has been framed so as to appeal as widely as possible to chemists, as many as five different subjects being down for discussion. Taking first those which have a practical bearing, the subject of the economical use of fuel is of national importance. The chemist can emphasise the wasteful nature of present practice and describe alternative and more economical practices, free from the bias of the commercial advocate. It is hoped to present at the meeting the views of authoritative speakers on all branches of the subject; the details will be announced later. The subject of metallurgy is of particular interest in Birmingham, and a number of papers are promised by Prof. Cohen, Prof. Turner, Dr. Desch, Dr. Rosenhain, Dr. Holt, and others, which will deal from the scientific side with problems of practical interest. Turning to pure chemistry, the discussion on optical activity should prove of particular value, as all the workers in this country who are specially competent to speak on the subject are expected to be present. The ground has been prepared by Prof. Frankland's summary in his presidential address to the Chemical Society, whilst new light has been thrown on it by the recent work of Prof. Armstrong and Mr. E. E. Walker. Although of a far more speculative character, the discussion on radio-active elements and the periodic law, which Prof. Soddy is to open, should attract a large audience. For the benefit of its biological followers, the section will cooperate with the Physiological and Agricultural Sections for a discussion of some of the elusive processes included in the title fermentation.

SECTION D (ZOOLOGY).—The programme of the proceedings of Section D contains many items of considerable interest. In addition to delivering his presidential address, Dr. Gadow will open a discussion on convergence in the mammalia; Prof. J. Versluys (Giessen) and Dr. Chalmers Mitchell will also take part, and the palæontological side will be represented. There are several entymological papers which will form an introduction to a discussion on mimicry, to be opened by Prof. E. B. Poulton.

There will be a joint session with the Physiological and Botanical Sections for a paper and demonstration by Prof. Benjamin Moore on the synthesis of organic matter by inorganic colloids in the presence of sunlight, considered in relation to the origin of life. A novel feature will be a demonstration in the Cinema Theatre by Prof. H. Braus (Heidelberg), "Mikrokino Aufnahmen von lebenden Kulturen embryonaler Herzen." These films have previously been shown in Berlin and Vienna, but not in this country. The same author is communicating a paper on the homology of the gills in the light of experimental investigation. Another paper by a distinguished foreign visitor is one on the carapace of the Chelonia, by Prof. J. Versluys.

The afternoon lecture will be given by Prof. E. A. Minchin, who will deal with "Some Aspects of the Sleeping Sickness Problem." An excursion will be made to Burbage, on the invitation of Major C. C. Hurst, to view a number of extremely interesting experiments in inheritance, but the number of members whom it is possible to accommodate must necessarily be strictly limited.

SECTION F (ECONOMIC SCIENCE AND STATISTICS).—After the presidential address by the Rev. P. Wicksteed, the discussion will be concentrated on certain subjects. One of these will be "The Cost of Living," which will be introduced by papers from Prof. Irving Fisher, of Yale, Prof. Bowley, Mrs. F. Wood, and Mr. Cuthbertson. The attitude of trade unions to profit-sharing and co-partnership will be dealt with by Dr. C. Carpenter and Mr. B. C. Kershaw. There will be an important discussion on inland waterways. Papers will be read by Lord Shuttleworth, Sir J. P. Griffith, Mr. W. M. Acworth, and Mr. R. B. Dunwoody; amongst the speakers will be Mr. Neville Chamberlain, Mr. Frank Impey, Mr. J. A. Sauer, Mr. Fred Morton, and Sir J. Brunner. Other papers of a more miscellaneous character will be read by Prof. Chapman, progressive taxation; Prof. Muirhead, the economic order; Mr. A. J. Kenny, on mathematical methods; Prof. Oldham, study of business organisation; Prof. Kirkaldy, the Panama Canal; Mr. C. R. Enoch, human geography and industry planning; Mr. F. Tillyard, towns in the nineteenth century.

SECTION H (ANTHROPOLOGY).—In this section the programme will, as usual, cover a wide field. It includes a number of communications of considerable interest and importance, especially in connection with the study of religion. Dr. W. H. R. Rivers will read a paper entitled "Sun-cult and Megaliths in Oceania," Dr. G. Landtman will give an account of the ideas of the Kiwai Papuans regarding the soul, and Mr. J. H. Powell will describe, with lantern illustrations, the ceremony of hook-swinging in India, while Mr. W. J. Perry will present to the section the results of an examination of the custom of orientation in Indonesia. Major Tremearne will deal, in two separate papers, with the Bori ceremony of the Hausas of Tunis and the magic of the Nigerian Hausas. Semitic medical magic and folklore, as exemplified in a number of unpublished formulæ from the inscriptions, will form the subject-matter of a communication from Mr. R. Campbell Thompson, who will also submit for the consideration of the section his suggested decipherment of the Hittite inscriptions. Egyptian archæology will be represented by papers from Prof. Flinders Petrie and others. Prof. Petrie also proposes to describe the results of an anthropometric examination of the skeletal remains found in his excavations during the past season. Among the remaining archæological communications may be mentioned Dr. Capitan's description of recent discoveries of paintings in the Palæolithic caves of France, and papers by Dr. Ashby on Italian archæology.

An interesting topic which has not been under discussion in the section for some considerable time will be touched upon in papers by Mr. T. W. Thompson, on gipsy tabus and funeral rites, and by Dr. Rivers and the Rev. G. Hall, on gipsy pedigrees.

Finally, mention must be made of a paper by Prof. Fleure and Mr. T. C. James on the ethnology of Wales, which is of a special importance not only on account of its conclusions, but as an example of a statistical method.

SECTION I (PHYSIOLOGY).—The main feature of interest in the Section of Physiology is that, for the first time, there will be a subsection of psychology in connection with the above section. This subsection ought to be very attractive, as a large number of papers have been promised. One meeting will be devoted to a joint sitting of the whole section to hear papers of interest to both physiologists and psychologists. During the rest of the meeting, however, the subsection will meet independently.

A discussion on the physiology of reproduction will be held jointly with the Section of Agriculture on Monday, September 15, and Dr. F. H. A. Marshall will open this discussion.

The address of the president of the section will open the meeting, and the reports of research committees will, as usual, be taken early in the meeting. The report of the committee on anæsthetics should lead to some discussion, as Sir Frederic Hewitt wishes to raise the subject of legislative restriction of the employment of anæsthetics. Another subject of interest will be a paper which Prof. B. Moore is giving before a joint meeting of zoologists, botanists, and physiologists, on the synthesis of organic matter by inorganic colloids in presence of sunlight, in relation to the origin of life.

SECTION L (EDUCATIONAL SCIENCE).—The sectional programme is unusually full and interesting. After the presidential address a joint meeting with Section H will discuss "The Educational Use of Museums," in which Dr. Hoyle, of the National Museum of Wales, Mr. Chubb, of the Liverpool Museum, Sir Richard Temple, Prof. Newberry, Dr. Harrison, and others will take part. On the following day a question of national importance is down, viz. "The Function of the Modern University in the State." As the academic heads of several of the universities concerned have promised to speak, the meeting should be a large one. Amongst others, Sir Alfred Hopkinson, Sir Harry Reichel, Dr. Hadow, Dr. Alex. Hill, Dr. H. A. L. Fisher, Miss Tuke, Sir James Yoxall, Mr. Alfred Moseley, Sir George Kenrick, and Miss Burstall are expected to take part. The president of the association will also come, unless Section A proves too attractive.

Following its custom of recent years, the section, meeting jointly with the Psychological Subsection, will give Monday to the consideration of psychological investigations, so far as they illuminate educational practice. Dr. Kimmins will read a paper on the need for educational research, which will be followed by a discussion, and papers on the psychological processes involved in learning to read and spell will be read. On Tuesday a demand for the registration of schools will be raised by Mrs. Bryant, Bishop Welldon, and Bishop McIntyre; and Mr. P. B. Ballard, Mr. T. S. Usherwood, and Mr. W. F. Fowler will present the case for handwork as a factor in education. On Wednesday, Sir George Fordham will read an important paper on the working of the Act of 1902. This should provoke considerable interest in view of coming legislation. Other papers to be read include one on "The Use of Suggestion in Discipline and Training," by Mrs. Meredith, and the Montessori method, by Dr. Jessie White.

SECTION M (AGRICULTURE).—As usual in the agricultural section, a special feature is being made of joint discussions with other sections. An important meeting is being held with the botanists, when prolificness of barley is to be discussed. The chief British authority, Mr. E. S. Beaven, is giving an account of his extensive trials, and Messrs. Hunter, Hackett, and Bennet are describing the experiments made by the Irish Department of Agriculture. Another meeting is arranged with the physiologists to discuss the factors influencing sterility and fecundity in live-stock. Dr. F. H. A. Marshall is opening the discussion, and Messrs. K. J. J. Mackenzie, L. Doncaster, G. W. Smith, and others are expected to take part. The section is also participating in the biochemical discussion on fermentation.

A number of papers of very general interest are promised. Sir Richard Paget is dealing with the possibility of partnership between landlord and tenant. Prof. Fraser Storey describes the German forestry methods, and Mr. Walter Collinge is to deal with a curious disease of cereals. Considerable attention is being devoted to soil problems. Mr. T. Goodey is giving a summary of his investigations at Rothamsted on the protozoa of the soil, and Dr. Hutchinson and Mr. McLennan are describing experiments showing that soil may be partially sterilised by means of caustic lime. Mr. C. T. Gimingham is presenting an account of ammonification and nitrification in pasture soils.

Ecologists will be interested in Dr. Winifred Brenchley's summary of the relationships of weeds to arable land. Miss Taylor is dealing with certain fruit problems, and Messrs. Barker and Gimingham with Bordeaux mixture. The foreign guest is Prof. Sörensen, from Copenhagen, who will be very generally welcomed by men of science in this country.

Altogether the programme promises to be of considerable interest. Among the excursions is a visit to the Burbage Experimental Station, where Major Hurst's breeding experiments are to be seen.

NOTES.

WE announce with great regret that Prof. Francis Gotch, F.R.S., Waynflete professor of physiology in the University of Oxford, died on July 15 at sixty years of age.

WE REGRET to announce the death on July 3, in his fifty-sixth year, of Dr. R. Lendlmayr von Lendenfeld, professor of zoology and rector of the German University at Prague.

PROF. A. FOWLER, F.R.S., has been awarded the Valz prize of 450 francs by the French Academy of Sciences for his investigation of the principal series of hydrogen lines and other contributions to astronomical physics.

DR. HANS BUSCH has taken over the editorship of the *Physikalischen Zeitschrift*, and it is requested that contributions for that journal be addressed to him at Göttingen, Friedländerweg 61.

THE death is reported, in his seventy-first year, of Dr. Charles Greene Rockwood, who was professor of mathematics and natural philosophy at Bowdoin College from 1868 to 1873, professor of mathematics and astronomy at Rutgers College from 1873 to 1877, and professor of mathematics at Princeton from 1877 to 1905. Prof. Rockwood was a member of the Princeton Eclipse Expedition to Colorado in 1878, and contributed a large number of articles on seismology to American scientific periodicals.

THE science section of the R. Accademia di Bologna has issued a circular relating to the first biennial prize of 3000 lire from the fund given by Prof. Elia De Cyon for the encouragement of scientific research. Memoirs are invited on a number of subjects, including the functions of the cardiac and vasomotor nervous systems, the functions of the thyroid and pineal glands, and of the labyrinth of the ear. The memoirs may be written in Latin, Italian, French, or English. The award will be made on March 1, 1915. Full particulars can be obtained from the secretary of the academy, Mr. Ercole Giacomini, at Bologna.

MR. JOHN MUIR, the American naturalist, is appealing to nature-lovers throughout the United States to use their influence to save the Yosemite National Park from spoliation. The city of San Francisco is trying to rush through Congress a Bill permitting it to acquire the Hetch Hetchy Valley as a site for a reservoir. The proposed scheme would turn this valley into a lake, and would close to the public the Grand Canyon of the Tuolumne, a river which at this point is a succession of waterfalls of every variety of height and beauty. This would mean depriving the rest of the United States of 500 square miles, or more than one-half the total area of the present National Park. Mr. Muir supports his protest by showing that this destructive scheme is not really essential to meeting the needs of San Francisco, which could find other, if more expensive, sources of water supply. He quotes the report of an advisory board of army engineers in support of this contention.

UNTIL quite recently the discovery of pygmy flints, established in England by Rev. R. A. Gatty, had not been confirmed in Scotland. Mr. R. M. Leslie Paterson, in *Man* for July, now reports the discovery of flints of this type near the confluence of the river Feugh with the Dee, on the 10-ft. terrace level. This district abounds in stone circles, and contains burial-places and pottery of the Bronze age, thus showing that it was continuously occupied by prehistoric man. The present discoveries include pygmy flints of various types—rough knives, duck-bill and thumb scrapers, borers, and a saw. But, curiously enough, not a single arrow-head has yet been found.

It has hitherto been believed that the Maori religion represented a cult of the powers of nature, with ancestor worship; that they had no conception of a Supreme Being, and that their deities were malevolent, to whom no true invocations were offered, but merely rude charms and incantations. In *Man* for July Mr. Elsdon Best, on information received from an old member of the tribe, describes the cult of one of the late Mr. Andrew Lang's "High Gods of Low Races," in the worship of a deity known as Io, whose name was deemed so sacred that it was never uttered in public. The priest is said to have performed his devotions in a secluded spot in the forest, or he used to enter a river in a state of nudity, and stood waist-deep in the water, having first immersed the upper part of his body. The account of this remarkable cult is full, and apparently authoritative, however it may conflict with our preconceived views of the religious beliefs of the Maori people.

We are indebted to the author, Mr. L. M. Lambe, for a copy of a paper from *The Ottawa Naturalist*, vol. xxvii., p. 21, on the bones of a fore-limb of an iguanodont dinosaur of the genus Trachodon from the Edmonton formation of Alberta, Canada.

In vol. ix., No. 11, of *The South African Journal of Science*, reference is made to the discovery in the Lower Cretaceous marls of Bushman's River—the locality where the type skull of Owen's *Anthodon serrarius* was obtained—of the broken femur of a reptile fully as large as the corresponding bone of Diplodocus, and, when complete, measuring about 5 ft. in length. Whether it belongs to Anthodon, now believed to be a dinosaur, remains to be proved.

Since the publication of Mr. Boulenger's volume on the reptiles and amphibians in the "Fauna of British India," two new species of land tortoises, namely *Testudo travancorica*, of the Western Ghats, and *T. baluchiorum*, from Baluchistan, have been added to the Indian list, while *T. latinuchalis* and *T. horsfieldi* have been shown to range into the British Indian area. A third new species, *T. parallelus*, from the Singhbhum district of Chota Nagpur, is described by Dr. Annandale in the second part of vol. ix. of Records of the Indian Museum. In the same paper Dr. Annandale also describes a new species of terrapin from Chota Nagpur, under the name of *Geoëmyda indopeninsularis*, which is of interest as showing that the genus Nicoria is inseparable from Geoëmyda, in the sense in which these terms are used in the "Fauna." This obviates much confusion in nomenclature, as it renders superfluous the name Heosemys, proposed by Dr. Stejneger to replace Geoëmyda, as employed by Mr. Boulenger.

The co-existence of man with extinct animals in South Africa forms the subject of an article by Dr. R. Broom in vol. xii., part 1, of the Annals of the South African Museum. The most convincing evidence of this is afforded by a layer of peat at Haagenstad salt-pan, about thirty miles north of Bloemfontein. Below the upper layer of pure peat, 8 to 10 ft. thick, is another layer, of about the same thickness, composed of peaty sand, and beneath this is a bed of broken bones, burnt bones, and human implements. Although most of the implements were unfortunately dispersed, a stone spear-head and knife secured for the Bloemfontein Museum amply attest their human origin. Among several species of extinct and existing mammals, special interest attaches to the frontlet and horn-cores of a gnu (*Connochœtes antiquus*), which are stated to be almost exactly intermediate in character between those of the white-tailed gnu (*C. gnu*) and the brindled gnu (*C. taurinus*). The same issue contains six papers, some by Dr. Broom, others by Mr. S. H. Haughton, and others by both writers, on new and other vertebrates from the Permo-Triassic beds of South Africa.

Dr. Hans Preuss has published (*Schriften der naturforsch. Ges.*, Danzig, Band 13) an elaborate account of the vegetation of the Baltic coast of Germany (Schleswig-Holstein, Mecklenburg, Pomerania, West and East Prussia), his paper of 213 pages being illustrated by sixty-two photographs. This important paper is of great interest to ecologists in Britain, since the maritime vegetation of the North German coast presents considerable general resemblances to that of our shores, apart from its greater richness in species and the presence of such groups as the "Pontic" forms, which have doubtless migrated from the warmer regions of Central Europe along the river valleys to parts of the Baltic littoral.

Prof. V. Arcichovskij has forwarded reprints of five recent papers appearing in various German and Russian journals. Two of these give descriptions of methods for experimental work with seeds freed from micro-organisms; in one of these the author describes and figures a modification of Hansen's sterile chamber, adapted for investigations with sterilised seeds and for pure cultures of higher plants. A third paper deals with the culture of higher plants in a simple air-chamber improvised from an ordinary flower-pot; excellent results were obtained in the cultivation of bean plants in moist air, the nodules being unusually large and numerous, as well as with other species, and the author advocates this method in preference to the use of water or sand cultures, in which access of air to the roots is hindered by the excess of water used.

Mr. J. F. Dastur, of the Agricultural Research Institute, Pusa, has published (Memoirs Dept. Agriculture in India, vol. v., No. 4) an account of a new disease of the castor-oil plant caused by *Phytophthora parasitica*, n. sp. In his introduction the author gives a brief account of the cultivation of the castor-oil plant in India, and the varied uses to which the oil is put besides that due to its medicinal properties. Though so widely distributed, this plant has hitherto been regarded as immune from serious fungus pests, except the castor rust, but at Pusa the crop has been attacked by two serious pests, the new Phytophthora now described and a species of Cercospora, to be dealt with later. The former destroys seedlings by causing "damping off," and also attacks leaves of older plants, and is the most injurious of the fungal parasites of castor. The structure and life-history of the fungus are fully described and illustrated by means of ten excellent plates, one being coloured to show the characteristic brown leaf spots which form the first external indication of the disease.

TECHNICAL BULLETIN No. 16 of the Michigan Agricultural College Experiment Station deals with the grain-size and moisture content of soil in relation to bacterial activity. Aëration and thickness of the moisture film may be considered to be the important physical factors of the soil in relation to the activity of aërobic bacteria. Aëration increases as the square of the grain-size, while the increase of the moisture film is directly proportional to the grain-size. A coarse soil is therefore of advantage to the aërobic bacteria. The grain-size in cultivated soils is generally so small that the optimum moisture film is reached only in the waterlogged state.

IN the Bulletin of the Imperial Earthquake Investigation Committee (vol. v., pp. 109–37), Prof. Omori again directs attention to the small slow movements of the ground which he calls pulsatory oscillations. The period of these oscillations ranges from about four to about eight seconds, and Prof. Omori shows that the period at a given moment is identical even at Tokyo and Osaka, which are nearly 250 miles apart, not only in its mean value, but also in its variation from day to day. The amplitude of the oscillations is much greater on soft than on hard ground, and Prof. Omori suggests that the oscillations are produced at some depth in the solid crust and magnified when transmitted to the soft soil of the alluvial plains. A remarkable feature of pulsatory oscillation is their complete dissimilarity at stations only a few miles apart, it being impossible to identify the different maximum groups even at two observatories in Tokyo. This indicates that pulsatory oscillations are not the results of a progressive disturbance like an earthquake. Prof. Omori regards them rather as the results of underground disturbances originating at an infinite number of points, due probably to volcanic activity or to changes in the internal pressure caused by the transit of a deep barometric depression or by the existence of heavy ocean swells.

MR. R. C. MOSSMAN (Argentine Meteorological Office) has contributed to *Symons's Meteorological Magazine* for June the third of his useful articles on southern hemisphere seasonal correlations. During the months January to March a remarkable parallelism is pointed out since 1897 in the curves of mean temperature at Alice Springs (Australia) and Cordoba (Argentine Republic), both stations being located in a continental situation. In eleven out of fourteen years discussed (1897–1910) the departures from the means for the period have the same sign. But previous years (1879–96) show no definite agreement. During the same months an opposition is generally shown in the mean temperature curves at Perth (Western Australia) on one hand, and at Valparaiso and Santiago (Chile) on the other; for Valparaiso data for only nine years (1901–9) were available. There is also an opposition between the mean temperature at Santiago and the thickness of the ice at Duluth (Lake Superior). These results, as Mr. Mossman remarks, are of interest as they indicate an interrelation between the action centres governing the conditions during the period in question in Australia, South America, and the United States.

A WELL-ILLUSTRATED article in the Journal of the Franklin Institute for May reproduces an address given before the institute in January by Mr. E. A. Sperry, president of the Sperry Gyroscope Company, and deals with the engineering applications of the gyrostat. It appears that the gyroscope has been successfully applied to the stabilising of the United States steamer *Worden*, and that the application has enabled a more complete study of the effects of rolling of vessels on the power necessary to propel them to be made. To the gyrostatic compass we have directed our readers' attention previously. The application of the gyrostat to the control of the wings and rudders of an aëroplane has now been successfully carried out, and we have, in addition, recorders of the rolling and pitching of vessels and artificial horizons depending on the gyrostatic principle, all working satisfactorily.

THE report of the Advisory Committee for Aëronautics for the year 1912–13 gives a general account of the work accomplished. The construction of the new four-foot wind channel at the National Physical Laboratory has been undertaken in the light of numerous experiments, and the pulsations in the flow which are the chief cause of difficulties in air-channel experiments have been so much reduced that the accuracy of individual measurements can be relied on in general to within one-half per cent. This channel replaces one of the same size, but a new 7-ft. channel is projected, and the necessary sum for its construction will be included in the estimates for 1913–14. In this respect the laboratory will be provided with means for experiments on fully rigged models of complete aëroplanes, an acceptable addition to its resources too long delayed. Amidst a number of interesting and important researches carried on, the investigation of the stability problem will command most attention, alike from mathematicians, physicists, and from those who have to trust themselves to their incessant vigilance to keep their frail craft upon an "even keel" in the air, and we therefore are glad to note that great advance has been made in the study and investigation of this problem, though sufficient time has not elapsed to put the knowledge so derived to the test of practical application. The close relationship between the work carried on at the Royal Aircraft Factory and that at the laboratory gives reason to hope that the inevitable divergence between laboratory and full-scale experiments will be ascertained and allowed for, and we are glad to note the cooperation that exists to forward the experiments. We hope to return to the work of this department of the laboratory when the technical report of the committee is ready.

IN a paper published in the *Gazzetta Chimica Italiana* (vol. xliii., i., 38) Prof. F. Angelico and Mr. F. Catalano have brought forward additional evidence in support of the generally accepted view that traces of formaldehyde are present in the foliage leaves of plants during the period of active assimilation under the influence of sunlight; they show, moreover, that formaldehyde is absent when the same plants are kept in darkness so as to suppress the chlorophyllian function. Parasitic plants, such as *Psalliota campestris* and Coprinus, which do not contain chlorophyll, also fail to give any indication of the presence of formaldehyde. The authors made use in their experiments of the glucoside atractylin, which is present in *Atractylis gummifera*; this substance they find to be the most delicate test yet devised for minute traces of formaldehyde; a solution obtained, for example, by adding three drops of 40 per cent. formaldehyde to one litre of water gives, under suitable conditions, a distinct violet coloration with the reagent. This behaviour is quite specific, no other aldehyde or substance responding in the same way.

THE report of the meeting of the Swiss Scientific Association held last autumn at Altdorf includes accounts of the many permanent commissions which the association has instituted. One of the most notable is in charge of the definitive edition of Euler's works; five volumes, including the "Algebra," "Dioptrica," and "Mechanica," have been published since 1911. The work of the geological commission and the glacier commission is prolific in measurements, maps, and observations. The nature protection commission, instituted in 1906, is successfully carrying out the project of a *grande réserve*, or national park, in the Grisons (the commune of Zernetz). Newly instituted is the commission for the study of atmospheric electricity. Among the papers read, a comprehensive study of the mountain structure of central Switzerland, by Dr. P. Arbenz, is one of the most considerable. Mr. Weiss discusses recent research in molecular physics, and his own work on magnetons. "Radiation and Matter," by von Kowalski, includes investigations in atmospheric electricity; Mr. R. Chodat describes the problems of plant-coloration and his own important experiments in this difficult subject. Mr. Pictet shows that the flight of insects in relation to artificial light is not a case of tropism. Very interesting conclusions on the effects of storms upon forests are drawn by Mr. van Ufford from the destruction of the forest at The Hague in 1911. Mr. Mirimanoff carries further than Poisson and Oettinger the mathematical theory of the game *trente et quarante*. The sixty-nine papers read at the meeting are well distributed among the various sciences, and deal in many cases with significant and important research.

PROF. J. WALKER, F.R.S., of Edinburgh University, is just completing a "Text-book of Organic Chemistry for Students of Medicine," which will shortly be published by Messrs. Gurney and Jackson, London, and Messrs. Oliver and Boyd, Edinburgh.—Dr. Reinheimer is about to issue through Messrs. Kegan Paul, Trench, Trübner and Co., Ltd., a volume entitled "Evolution by Co-operation: A Study in Bio-Economics."—"The Living Plant," a description and interpretation of its functions and structure, by Dr. W. F. Ganong, will be published shortly by Messrs. Constable and Co., Ltd.

OUR ASTRONOMICAL COLUMN.

A METEORITE SEEN TO FALL AND FOUND.—It is not often that a meteorite is actually seen to fall to the ground, but this was the case with the specimen described by Messrs. Masumi Chikashige and Tadasu Hiki, in the Memoirs of the College of Science and Engineering, Kyoto Imperial University (vol. v., No. 1, September, 1912). It was at 6.30 on the morning of April 7, 1904, that the meteorite fell at the village of Okano, in the neighbourhood of the town Sasayama, in the province of Tamba, Japan. The white glowing mass was observed by a peasant, and when he came to the spot he found a stone which looked like a block of iron with the long point upwards, and imbedded about 80 cm. A teacher 30 km. to the north observed the meteorite also as a white glowing mass, at an altitude of about 70°. The chemical analysis, which is given in the paper, is as follows, in percentages:—Iron, 94·85; nickel, 4·44; cobalt, 0·48; copper, trace; phosphorus, 0·23. Thus nickel-iron amounted to 98·52 per cent., and phosphor-nickel-iron 1·48 per cent. This result is very similar to that obtained in the De Sotoville meteorite, namely nickel-iron 98·71 per cent., and phosphor-nickel-iron 1·29 per cent. The authors complete their monograph with three excellent plates showing the external appearance of the meteorite and sections before and after treatment.

MEASURES OF PROPER MOTION STARS.—The Carnegie Institution of Washington has just issued another large volume (No. 168), the contents of which in this case consist of the valuable series of measures of proper motion stars made by Mr. Burnham with the 40-in. refractor of the Yerkes Observatory in the years 1907 to 1912. Attention may be directed in the first instance to the promptitude of publication of such a mass of valuable data, for this large volume, containing no fewer than 311 pages, includes measures so recently made as last year. The total number of measures made in the present work is about 9500, and all places are given for 1880 unless otherwise mentioned. The original places as given in the General Catalogue of Double Stars have been retained, and the stars in part i. reduced to the same epoch. The measures are published in two parts. The larger number of stars selected for measurement are given in part ii. of this volume, and are taken from the General Catalogue of Double Stars for reasons stated in the notes and observations in that work. Part i. includes all other stars for which prior observations with the micrometer have been made. The small stars from zone 26° of the Oxford Astrographic Catalogue were compared with one or more fainter stars in the field. Mr. Burnham has added three more stars, namely 37 Tauri, 55 Tauri (OΣ 79), and OΣ 82, to the list of Boss's thirty-nine bright stars, principally in Taurus, which appeared to have a common proper motion of approximately 0·10″ in the general direction of about 100°.

THE TOTAL SOLAR ECLIPSE OF AUGUST 30, 1905.—In a beautifully got-up portfolio measuring about 20×25 in., just issued by the Hamburg Observatory, Prof. R. Schorr publishes a series of nine reproductions illustrating the photographs of the corona he and his party secured during their expedition to Souk-Abras, in Algeria, in August, 1905. Perfect weather was experienced on this occasion, and the programme was carried out in its entirety. When it is stated that the diameter of the moon on these plates measures 7·5 inches, the scale of the reproductions can be better understood. The main object of the expedition was to obtain the structure of the inner corona by means of photography, and for this purpose a horizontal telescope of 20 metres focal length was used, fed by a cœlostat. The objective itself was by Zeiss, and of 160 mm. aperture, and achromatised for wave-lengths 531·7 and 405·1 $\mu\mu$, the resulting solar image being 19 cm. in diameter. In the introduction to these plates Prof. Schorr gives details as to the kind of photographic plates used, and the details of exposure. Great pains seem to have been taken to make the reproductions as representative of the original negatives as possible, and the result is remarkably successful. Each plate is accompanied by a celluloid sheet over it, on which the correct orientation and prominent features are marked. The last plate is a reproduction of a drawing by Dr. Graff of the structure of the inner corona, in which are combined the details shown in all the negatives. Fortunately, on the occasion of that eclipse the corona was fully of quite extraordinary detail, especially in form, and this record is therefore of particular interest. The atlas is a valuable outcome of a most successful expedition.

KELVIN MEMORIAL WINDOW.

THE memorial window to Lord Kelvin, subscribed for by engineers in Great Britain, Canada, and the United States, was dedicated at a special service in Westminster Abbey on Tuesday. The window is in the east bay of the nave on the north side. The light from it falls upon the graves of Kelvin and Isaac Newton, and immediately beneath it are the graves of Darwin and Herschel. The window, which was designed by Mr. J. N. Comper, is chiefly ecclesiastical and historical in character. The lights contain two large figures under canopies; and in front of the pedestals of these two figures are tablets held by angels, containing the words:—"(1) In memory of Baron Kelvin of Largs, (2) engineer, natural philosopher, b. 1824, d. 1907." Beneath these again are the arms of Lord Kelvin and of Glasgow University.

The Dean of Westminster, in the course of an address, is reported by *The Times* to have said that forty years ago there were at Cambridge an extraordinary constellation of great men of mathematical genius—Adams, Clerk-Maxwell, Cayley, and Stokes—occupying professorial chairs. Of the four, two had been justly commemorated in the north aisle of the Abbey. Another Cambridge man, William Thomson, was destined to surpass his four friends. In originality, in range of study, in ingenuity and resource, Kelvin was pre-eminent. It was said by Goethe that to make an effort in the world two conditions were essential—a good head and a good inheritance. Lord Kelvin and his four friends had both. The new world of electricity had been already discovered. They entered into that inheritance and transformed its glories for the practical utility of mankind. It was Kelvin who subdued the whole province of the new realm of science. All through his life, in the face of a strong prevailing current of materialism, Kelvin preserved the simplicity of his early Christian faith. He wrote in 1892: "The real phenomenon of life infinitely transcends human science." He spoke with the humility of a great man, and many could look back with gratitude to the example which the religious belief of a man of his gigantic intellect furnished to those of a younger generation. His name was one of the most epoch-making in the domain of natural philosophy.

The chairman of the Memorial Committee then offered the window to the Abbey, and it was gratefully accepted by the Dean on behalf of himself and the Chapter.

THE EXETER MEETING OF THE ROYAL SANITARY INSTITUTE

AT the twenty-eighth congress of the Royal Sanitary Institute, held at Exeter on July 7–12, many useful papers were contributed, one or two of which dealt with research work of scientific interest.

Mr. James Crabtree contributed a paper which embodied some experiments on the lines of those carried out by Dr. E. J. Russell and his co-workers on the part played by protozoa in soils, the experiments here recorded relating to sewage disposal beds. From these experiments it is evident that the fauna of the bacteria bed play an important part in keeping the bed open and porous; it seems probable that they play a further part by the actual digestion of some of the more easily resolvable colloidal matter precipitated on the beds. The conclusion arrived at is that the animal population of the bacteria (contact) bed is entirely advantageous in maintaining the capacity of the bed, probably in keeping down extraneous bacteria, and thus assisting purification to some extent, and also by bringing about some actual digestion of colloidal deposited matter.

Dr. Gilbert G. Fowler and Mr. E. Moore Mumford contributed an interesting paper on the bacterial clarification of sewage. The area and cost of sewage filter beds depends mainly upon the amount of colloidal matter present in the sewage, and some confusion of ideas is probably due to the fact that the ordinary sewage filter is called upon to do two entirely different things at the same time, namely on one hand to oxidise, granulate, and finally discharge as humus the colloidal matters present, and, on the other, to oxidise and nitrify substances in true solution. If this oxidising and coagulating process could be brought about by suitable open-tank treatment before the filtration process, it is obvious that the latter could be enormously accelerated, if not dispensed with altogether; and the whole operation of sewage treatment could be conducted on a much smaller area.

In the course of a research on another matter, one of the authors had occasion to study the reactions of an organism occurring in nature in pit-water impregnated with iron. This organism is a true facultative organism, preferably an aërobe, and it exercises a specific action on iron solutions. The action of the bacillus on iron solutions proceeds in two stages, in which the aërobic and anaërobic actions appear to be symbiotic, at any rate under the conditions occurring in nature. The aërobic action is to precipitate ferric hydroxide from iron solutions; while the anaërobic action is to transform the hydroxide thus precipitated into bog ore, with partial reduction of the iron to a ferrous state. It was found that in order to precipitate the iron sufficiently the organism required a certain proportion of albuminoid organic matter. It was, therefore, natural to expect that ordinary sewage matter could be utilised in this way. Experiment, in fact, showed that a previously sedimented sewage effluent could be effectively clarified in this way when acted upon by this organism in presence of small quantities of ferric salts, aërobic conditions being maintained in the liquid by means of a current of air. An experimental plant has been erected at the University of Manchester, which will permit of accurate observations of this process and the collection of further detail.

Mr. F. Southerden has extended the investigations made at Leeds, Glasgow, and London, upon atmospheric pollution, to the atmosphere over the city of Exeter and its immediate surroundings. He finds that rain-water collected less than a mile from the centre of the city is very noticeably superior to that collected more centrally, the proportion of dissolved solids and sulphate reaching only about one-half, but there is no marked difference as regards the chlorine or ammonia, and so he concludes that these are derived in the main from sources other than coal smoke. The experiments make it clear that the atmospheric pollution of Exeter, though less in amount, is similar in its nature to that in larger towns.

Mr. Southerden also gave the results of his investigations upon the effect of coal smoke on the stonework of Exeter Cathedral. The stonework consists of limestone of varying quality and texture, and the oxy-acids of sulphur derived from the combustion of coal convert the calcium carbonate of the stone into soluble calcium sulphate, and the surface of the stones slowly crystallises and expands in such a way that disintegration results. The author concludes that the exact conditions which lead to scaling are not simple, but the extent of sulphate formation appears to be an important factor, and the destructive influence of sulphuric acid is doubly important, for in the more sheltered situations it leads to disintegration by scaling, and in exposed positions calcium sulphate is formed and dissolved away, thus hastening the destruction brought about by more natural agencies, such as frost, wind, and rain. The blackening which is very noticeable on portions of the stone structure is due to a thin film of soot, from which it has been possible to extract a small amount of tar.

REPORT OF THE ADVISORY COMMITTEE ON FORESTRY.

A FEW weeks ago was issued a Blue-book of general interest, the Report of the Advisory Committee on Forestry for the period July to October, 1912 (Cd. 6713, price 6*d*.). The Advisory Committee on Forestry comprises such well-known names as Sir E. Stafford Howard, Sir S. Eardley-Wilmot (late Inspector-General of Forests, India), Sir D. Prain (director of Kew), Sir William Schlich (the Oxford professor of forestry), and Prof. Somerville, of the Oxford School of Rural Economics, who is perhaps as well known for his writings on forestry as for those on agriculture; and Mr. E. R. Pratt, president of the Royal English Arboricultural Society. Of the ten members of the Committee only four are professional foresters, so that the professional element is not even in a majority. Mr. R. L. Robinson, the chief of the forestry branch of the Board of Agriculture and Fisheries, fulfills the office of secretary to the Advisory Committee, and is apparently the author of the two chief appendices to the report, though one of these is not signed. These appendices, on forest research and development, contain a mass of technical information and interesting general observations, which will well repay perusal by those interested in British forestry.

The Blue-book contains the advice of the Forestry Committee on three questions submitted to it for opinion by Mr. Runciman.

The first of these questions relates to forest surveys, which it is advised should be divided into two classes: (*a*) preliminary or flying surveys, (*b*) detailed surveys.

The surveys proposed should bring together much useful information, and supply a long-felt want in the cartography of these islands. We have excellent geological, topographical, meteorological, and other maps; but he who wishes to see what is the extent and value of the woodlands must be satisfied with the ordinary ordnance maps and a few forest maps. The ordnance maps give no indication of the quality, and are often misleading as to the quantity, of the forest. Yet few of the special maps that exist have the importance of a forest map, with the national issue of 30,000,000*l*. yearly sent out of the country for timber and forest produce, which could be produced easily in these islands! The extension of forest surveys is therefore an excellent scheme, which should meet with universal approval.

When, however, we go on to read that surveys of both types are necessary "*as a preliminary step towards the inauguration of afforestation operations*," the forest surveys assume a sinister aspect. If they are to be taken as an excuse for postponing the commencement of practical forestry, the country will be better without them. This, perhaps, is why Mr. Munro Ferguson adds his rider to the report: "I am of opinion that 2000*l*. is a sufficient sum to apply for survey work for the next two years, after which the expenditure could be reviewed in the light of experience." In the estimate at p. 50, the total cost of the surveys is given at 35,000*l*., and the time at eleven years; and this is for a partial survey, not embracing the whole of the seven areas mentioned in the report of the Advisory Committee. These seven areas for the forest surveys are:—

1. South Wales.
2. North Wales.
3. Westmorland, Cumberland, and Northumberland.
4. Kent, Surrey, and Sussex.
5. Berks, Hants, Wilts, and Dorset.
6. Derby, Lancashire, and the West Riding.
7. Lincoln, Norfolk, Suffolk, and Essex.

It is recommended that surveys be begun in districts 1, 3, 4, and 7, and that in conducting these preliminary surveys use should be made to the fullest extent of the knowledge which local owners, foresters, and agents possess. The cooperation of the Royal English Arboricultural Society and of local committees is also invited. This is excellent.

The report expresses doubts as to the advisability of publishing these forest surveys. It is not clear wherein lies the difficulty of doing so, but obviously they should be of much general utility, both to the public at large and the student of forestry.

The second question on which the advice of the Forestry Committee has been asked relates to "demonstration areas." These have figured largely in British forest literature of recent years, and the Advisory Committee states that "it has received their very careful consideration" (though, indeed, this phrase is repeated in the answer to each question). It seems possible that forest demonstration areas are one of those side issues which during the last three years in British forestry have served to distract attention from the main question—the inauguration of practical forestry by the acquisition and planting of ground on a large scale. Here Mr. Munro Ferguson has added another rider which will receive the hearty approval of every forester—"I agree with paragraph 6, that the Forest of Dean, with the adjoining Crown woods, is well suited to meet the requirements imposed by a demonstration forest, and am of opinion, therefore, that the whole area should be removed from the control of the deputy-surveyor and placed under a trained forest officer." Some years ago, when the post of deputy-surveyor of the Forest of Dean became vacant, some 600 applications were received for the vacant post, one of them actually being a worthy minister of a local Methodist connection. This shows the loose manner in which forest appointments had come to be regarded in this country. At that time there were probably not a dozen quite qualified foresters available in the whole of Britain.

Rules are framed for the maintenance of experimental plots in private forests. It is possible that in some cases useful purposes may be served by these rules; but it may be anticipated that most frequently we shall find the private forest owner conducting useful experiments in his own forests; and the forest officers, with their wider facilities, carrying on their own experiments in the State forests.

The third reference relates to the training of woodmen, both foremen woodmen and the more fortunate men whose lot it is to work with their own hands. Those who have had experience of the excellent training given in the Government school in the Forest of Dean would endorse all that is here said in its favour. The two forest schools, in the Forest of Dean and in the Chopwell Woods (county of Durham), provide for the training of about fourteen men yearly. We heartily endorse the recommendation that increased provision should be made for the training of men of their type. The census of 1901 returned 12,035 woodmen employed in England and Wales.

The appearance of this Forestry Blue-book is opportune; it shows that Mr. Runciman is actuated by an earnest wish to break away from the difficulties and delays that have so long beset British forestry. It is indeed time that the first sod in practical British forestry were turned. While the Development Commission, with its grant of 500,000*l.* yearly, has been running for three years, no beginning in practical State forestry has yet been made in Britain.

It is not evident from a perusal of the Blue-book why there should be further delay. The obvious course to be followed now is at once to open negotiations for the acquiring of land—either by direct negotiation, or by purchase as it comes into the market; and, so soon as an area has been secured, to depute the competent forest officials in the Whitehall Forest Office to proceed with the planting, in consultation with local opinion and experience. The examination of sites for State forests seems to offer scope for the energies of the five forest advisors recently appointed to the five forest areas into which England and Wales have been divided. These forest advisors are stationed at Oxford, Cambridge, Cirencester, Bangor, and Newcastle.

Following the practice of other countries, the State forest nurseries referred to in the Blue-book should be initiated, as early as may be; not only for the supply of young trees at economical rates for planting in the State forest, but for *free issue to private forest owners*, and to such municipal or other public bodies as may be disposed to undertake forest planting on their own account. The private forest owner in Britain has had a hard time these last years, with falling prices for timber and underwood, and increased taxation. The woodlands that he maintains are a national benefit, and he may well ask that the State should now help him with something more substantial than good advice in forestry!

A somewhat pressing question that the Advisory Committee has not yet touched upon is what monetary contribution, if any, should be allowed to municipal (or other corporate) forest planters by way of grant-in-aid, in the case of loss on their forest planting. India and Cape Colony are, in State forestry, some thirty years ahead of this country and the other British Colonies. For many years in Cape Colony municipal and other non-private planting has been aided on the 1*l.* for 1*l.* principle; that is to say, to every 1*l.* of approved forest expenditure Government has added another 1*l.* With this contribution the State retains certain guarantees for the proper management of the forest or trees planted.

It is, as we have seen, now three years since the Development Commission obtained the grant of half a million a year for developing the natural resources of the country in various ways, the most lasting and far-reaching of these ways being forestry. During the first year provision was made for the planting of about ten square miles of forest in Ireland; but in Great Britain to this day no decided step has been taken in practical State forestry. We may therefore express the very earnest wish that, useful though the contemplated forest surveys may be, they will not be allowed to delay, for one day, the initiation of State forestry in Britain.

In the present season of the year, England is beautiful, almost in proportion to its woodedness! Every consideration of sentiment and hard fact demands the beginning, without further delay, of practical afforestation.

ORNITHOLOGICAL NOTES.

IN view of persistent reports as to the marked decrease, or even disappearance, of the landrail, or corncrake, as a breeding bird in many parts of the country, more especially the eastern and south-eastern counties, the editors have issued with the June number of *British Birds* a schedule of inquiries on this matter. In a covering note Dr. Ticehurst points out that answers should be strictly limited to the presence or absence, now or in the past, and the relative numbers and changes in numbers, of breeding birds in different districts.

A beautifully illustrated article on the albatrosses of Laysan Island, in the South Pacific, appears in the April number of *The American Museum Journal*, based on a visit paid to that wonderful bird-resort by Mr. H. B. Dill in 1911. In spite of periodical raids by plumage-hunters, the albatrosses still retain their original lack of fear, parties of them walking up to a visitor as if to greet him. Some idea of the vast numbers of sea-birds on the island may be gathered from an estimate that their daily product of guano is about 100 tons. Some years ago a company was started to work this guano, but the venture was not a success, owing to the fact that the frequent rains wash out a large proportion of the ammonia from the deposits.

To the April number of *The Emu* (vol. xii., part 4) Dr. R. W. Shufeldt contributes an illustrated article on the osteology of the Cape Barron goose (*Cereopsis novae-hollandiae*). Although the skull presents certain well-marked peculiarities, the rest of the skeleton is that of a typical goose. The genus has been assigned to a special subfamily, but the affinities of the bird are clearly with the snow-goose (*Chen hyperboreus*).

According to *The Christian Science Monitor*, Boston, Mass., of May 29, Mr. R. C. Murphy has returned to New York from an ornithological expedition to South Georgia, bringing with him 500 skins and skeletons of large sea-birds, while others are to follow. These are to be divided between the American Museum of Natural History and the Brooklyn Institute of Arts and Sciences. Mr. Murphy states that on a small island a mile in diameter he has seen 4000 pairs of birds nesting on the ground. The principal specimens represent albatrosses, petrels, and three kinds of penguins. R. L.

GREAT ADVANCE IN CRYSTALLOGRAPHY.[1]

TWO pictures of the actual apparatus employed (one of which is produced in Fig. 7), and an explanatory diagram of it (Fig. 8), will enable the precise nature of the experiment to be grasped. A plate, 1 cm. square and 0·5 mm. thick, was cut from a good crystal of zinc blende parallel to a cube face, and

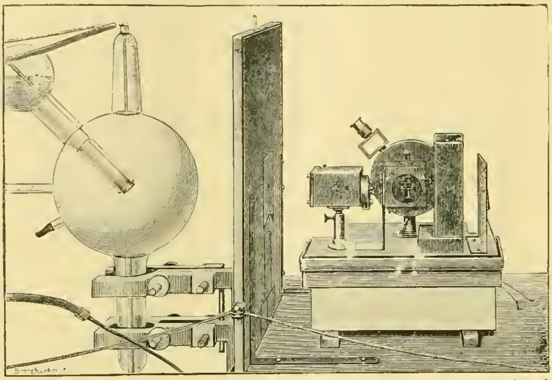

FIG. 7.—Apparatus of Friedrich, Knipping, and Laue for passing X-rays through crystals and photographing the effect.

adjusted on the crystal holder of a goniometer in the path of a very narrow pencil of X-rays from the bulb, isolated by their passage through a succession of lead screens (lead being impervious to X-rays) pierced by small holes. The last screen, which gave the final form to the pencil of rays, was a plate of lead 1 cm. thick, pierced by a cylindrical hole 0·75 mm. in diameter, and fitted with a delicate means of adjustment so that the axis of the boring could be brought

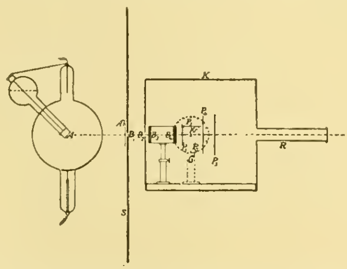

FIG. 8.—Diagrammatic representation of apparatus of Friedrich, Knipping, and Laue. A, Antikathode of X-ray bulb; B_1, B_2, B_3, B_4, diaphragms of lead; K, leaden box-screen with tubular termination R; S, large leaden screen; G, goniometer; P_1, P_2, P_3, P_4, P_5, photographic plates; Kr, Crystal; Al, aluminium plate.

exactly perpendicular to the crystal plate. The beam of pure X-rays of circular section, after passing normally through the crystal plate, was received on a Schleussner-Röntgen photographic plate, which was afterwards developed with rodinal.

The developed plate showed an intense circular spot at the centre, caused by the direct X-rays, and a considerable number of other spots of elliptical shape, arranged in a geometrical pattern. Three of these original photographs are exhibited on the screen (and two are also reproduced in Figs. 9 and 10). If a series of such photographic plates be used, at different distances from the crystal (as for Figs. 9 and 10), the fact is revealed that the spots are formed by rectilinear pencils of rays spreading in all directions from the crystal, and some of them inclined more than 45° to the direction of the incident rays. These deflected beams show similar properties to the original X-rays, ionising air and helium just like the latter, and with the same degree of variation with the pressure. Hence, there can be no doubt that the character of these deflected rays issuing from the crystal is that of unaltered X-rays, and that they are due to the deflection of X-rays by planes situated at different angular positions in the interior of the crystal. In short, we are in face of reflection of X-rays from planes of atoms in the crystal.

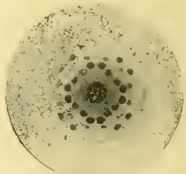

FIG. 9.—Spot photograph afforded by zinc blende. Incident X-rays perpendicular to a cube-face, and parallel to a tetragonal axis of symmetry.

Now a study of the spots reveals the further interesting fact that the pattern shows the full symmetry (that of class 32) of the cubic system to which the

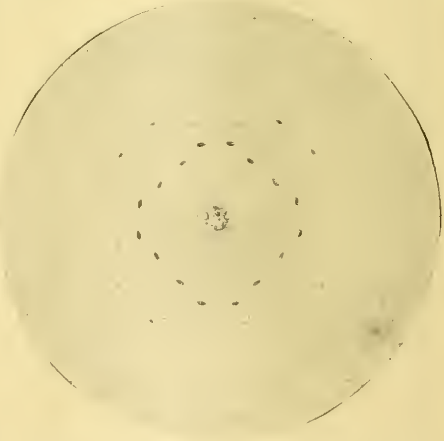

FIG. 10.—Spot photograph afforded by zinc blende. Incident X-rays perpendicular to a cube-face, and parallel to a tetragonal axis of symmetry.

crystal belongs, although zinc blende exhibits the slightly lower symmetry of the hexakis-tetrahedral class (31), one of the formerly so-called hemihedral classes of the cubic system. This clearly proves that it is the planes of similar and similarly situated (same-

[1] From a discourse delivered at the Royal Institution on Friday, March 14, by Dr. A. E. H. Tutton, F.R.S. (continued from p. 494).

ways orientated) atoms in the crystal that are producing the reflections; in other words, the planes of the space-lattice.

At first Laue, who published a separate memoir on the theory of the experiments, considered that it was the space-lattice due to similarly situated zinc atoms which afforded the spot patterns, as he had been engaged with Prof. Summerfeld in experiments relating to the action of zinc on X-rays. But there appears no reason why the sulphur atoms should not be similarly capable of producing reflections of these extremely fine vibrations of corpuscles, and as the space-lattice is the same for both elements, according to all versions of the geometrical theory of crystal structure, there is really no reason why we should not consider the reflections as due to the general space-lattice of zinc blende. Laue considered the "molecules" of the crystal to form a three-dimensional grating—that is, a Raumgitter—and that each molecule is capable of emitting secondary vibrations when struck by incident electromagnetic waves from the X-ray bulb; also that the molecules are arranged according to the simple cube space-lattice (No. 1). The incident waves being propagated parallel to one of the cube axes (edges), the wave-surfaces will be parallel to the plane of the other two cube edges. He then considers the spots to be interference maxima of the waves scattered by the orderly arrangement of the molecules in the crystal. The equations of condition were next found for interference maxima of direction cosines α, β, γ, and for incident wave-length λ, and from the position of each spot the direction cosine of the pencil of rays which formed it was calculated, assuming all the transmitted pencils to come from the centre of the crystal. Thirteen spots in each quadrant were investigated, and in every case Laue's equations were satisfied; hence, the conclusion that the spots are due to interference of secondary Röntgen radiation appears to agree with the positions of the spots, provided only radiations of certain definite wave-lengths are present in the incident rays.

The lecturer pointed out, in an article in NATURE of November 14, 1912, that the structure of zinc blende was probably not so simple as had been assumed by Laue, and that the space-lattice with a point at the centre of each side of the cube (No. 3) was the more probable one, the structure being that assigned to it by Barlow and Pope, as already described in this lecture.

A satisfactory explanation has since been advanced by W. L. Bragg, which does accord with this structure and with other essential conditions referred to by the lecturer, altogether avoids the assumption of only a few wave-lengths, and agrees with a simple reflection of unchanged X-rays from the planes of points of the general space-lattice of zinc blende. He regards the incident radiation as composed of a series of independent pulses, which, falling on a number of atoms definitely scattered in a plane, are separately reflected, each atom acting as a centre of a secondary wave, and the whole building up a wave-front. The interference maximum is thus due to the reflection of the incident pulses from a system of parallel planes of similar atoms, that is, from one of the parallel series of planes of the space-lattice. Now besides the principal planes of the space-lattice, the cube planes, the points of the space-lattice also lie in a considerable number of other planes, all of which are possible crystal faces corresponding to rational indices. For instance, the octahedral planes are very easily traced, as also those of the rhombic dodecahedron. A minute fraction of the energy of a pulse traversing the crystal will be reflected from each parallel plane in succession, and the corresponding interference maximum will be produced by a train of reflected pulses. The crystal thus actually manufactures rays of definite wave-lengths, just as a diffraction grating does, the only difference being here in the extremely short length of the waves, which is the very reason why X-rays can penetrate in this manner into the Raumgitter structure. Each incident pulse produces a train of pulses, resolvable into a series of wave-lengths, λ, $\lambda/2$, $\lambda/3$, $\lambda/4$, &c., where $\lambda = 2d \cos\theta$, d being the shortest distance between successive identical parallel planes in the crystal, and θ the angle of incidence of the primary X-rays on the plane of points of the space-lattice. The intensity of any spot depends on the energy in the spectrum of the incident radiation characteristic of the corresponding wave-length, and this varies considerably so that certain parts of the spectrum are much more pronounced than others. Also it depends on the number of reflecting atoms in the plane—that is, on the reticular density of the possible crystal face corresponding to the plane. Hence, the greater the reticular density, the more intense the spot produced in the photograph. As reticular density is also proportional to importance of face, the primary faces having the greatest reticular density, it follows that the most important facial planes reflect the intensest spots, a fact which may prove of great value in enabling us to discover the real primary planes in doubtful cases. Each spot reflected by a plane (considered as passing through the origin and two other points) lies at the intersection of two ellipses, and the figure on the screen, showing an analysis of one of the spot photographs, exhibits this clearly. Indeed, the plane of atoms corresponding to any spot can be found from the two ellipses; for each ellipse is the section of a cone by the plane of the photographic plate, the axis of the cone being the line joining the origin (centre of the triaxial system, and considered as one of the three points determining the plane) and the particular atom (the second or third point of the three, of definite coordinates), and the generator of the cone being the incident beam.

The interesting results of Bragg are in full accord with the assumption of the centred-face cubic space-lattice (No. 3), but not with either the simple-cube or the centred-cube space-lattice (Nos. 1 and 2). They also account for the elliptical shape of the spots. The amount of ellipticity depends on the distance of the photographic plate from the crystal. When the two are very close the spots are round, but they become more and more elliptical as the plate is receded (compare Figs. 9 and 10). The phenomenon is due to the fact that the initial rays are not strictly parallel, and the effect will be clear from the next slide. The vertically diverging rays striking the reflecting planes of the upper part of the crystal meet them at a less angle of incidence than those of the lower part, and so the reflected rays converge. Horizontally diverging rays, however, diverge still more on reflection. Hence the section of the reflected beam is an ellipse with major axis horizontal.

It is of importance to note that the centred-face cubic space-lattice is characteristic both of the arrangement of identically (sameways) orientated and environed atoms of the same element, zinc or sulphur, and of the atoms of both elements regarded as equal spheres in contact. In the slide already shown (Fig. 5), of Barlow and Pope's model, the spheres of sulphur are coloured yellow to distinguish them from the grey-coloured spheres of zinc. If we ignore the colour and consider them as similar spheres, we see that they form the centred-face cubic arrangement. The hemihedral nature of zinc blende is, however, very likely connected with some real difference of volume between the atomic spheres.[5] As the spot figure is holohedral it would appear to be due to the space-lattices of similarly placed atoms of either (but in each lattice only one) element, rather than to the spheres of the combined system of atoms.

This latter conclusion is further borne out by the result of the new work by Laue on quartz. The photograph now shown, so kindly sent by Prof. Laue, exhibits the trigonal nature of the symmetry very clearly, and Prof. Laue informs me that the same figure is afforded by both right and left quartz, so that it does not reveal the hemihedral character of quartz, but possesses the full holohedral symmetry of the trigonal space-lattice, and exhibits the threefold nature of the axis of symmetry which is perpendicular to the plate and along which the X-rays were directed.

Prof. Laue has also experimented with the crystals of a number of other cubic substances, and, like zinc blende, they all show holohedral symmetry about a tetragonal axis.

W. L. Bragg has found that stronger photographs of the same nature can be obtained from mica, using nearly grazing incidence, and it is by use of this fact that Mosely and Darwin have been able to study the reflected rays electrically, and found them to resemble ordinary X-rays. By the kindness of Mr. Bragg, a diagram of his apparatus and a positive lantern slide of one of his mica spot photographs are exhibited on the screen.

Incidentally these experiments appear likely to throw light on the much-debated question of the nature of the X-rays. As all the experiments unite in indicating that a fraction of the X-rays suffers reflection at the planes of atoms parallel to the more important possible crystal faces, all being planes of atomic points of the space-lattice, it would appear that the X-rays are some type of wave-motion, or at any rate some kind of pulse with an extended wave-front. Yet after reflection they retain the same corpuscular character which Prof. W. H. Bragg has shown they possess. For the liberation of a high-speed electron from an atom traversed by the X-ray cannot be explained, according to Rutherford, unless it be supposed that the energy of the X-ray is concentrated over a minute volume, and can be given up in an encounter with a single atom. Hence these experiments show that the X-rays possess at the same time the apparently opposite properties of extension over a wave-front and concentration in a corpuscular point.

It appears to the lecturer that the simpler explanation is that we are truly dealing with waves, but that the wave-lengths of the X-rays are excessively short, approaching atomic dimensions, and that the amplitude of the effective waves is actually smaller than the reflecting atom. This view that the X-rays are waves is further supported by the results of some experiments just completed by Barkla, in which a diverging pencil of X-rays was directed on a crystal of rock-salt, and the issuing rays received on a photographic plate in the same manner as in the experiments already described. The developed plate shows a new phenomenon, namely, striation of the spots obtained by reflection from the planes of atoms of the space-lattice, especially in the reflections from the cubic cleavage planes. The striations are, in fact, true interference bands, due to interference of the reflections from equally spaced parallel planes of the space-lattice. By the kind courtesy of Prof. Barkla, two of these interesting photographs are projected on the screen. On the assumption that the X-rays are waves, and that the reflecting plane is one passing through corresponding portions of single NaCl molecules—which agrees with the choice of a representative point from each simple molecular grosser unit, or of a similarly situated atom of one of the two chemical elements present in each molecule NaCl to act as such representative point of the space-lattice—Barkla has calculated that the wave-length is the one hundred and sixty millionth of a millimetre, $0{\cdot}6 \times 10^{-8}$ mm. If the grosser unit be polymolecular, the wave-length works out larger, being proportional to the cube root of the number of atoms in the molecule. If eight molecules form the grosser unit of sodium chloride crystals, as suggested by some chemists, the wave-length is found by Barkla to be twice this value, namely $1{\cdot}2 \times 10^{-8}$ mm.; and if sixteen molecules of NaCl are comprised in the grosser unit, as would be the case if Barlow and Pope's structure for the cubic binary compounds be correct (the space-lattice in the case of rock-salt being that of the simple cube, No. 1), the wave-length would be still longer, about the seventy millionth of a millimetre, $1{\cdot}5 \times 10^{-8}$ mm. Now it is very interesting that these values are of the same order as those derived from determinations of the velocity of electron ejection, which varied from 1 to 2×10^{-8} mm.

The most trustworthy recent estimations of the size of a molecule of rock-salt indicate a diameter about 3×10^{-7} mm. Hence the diameter of a crystallographic molecule 8NaCl would be 6×10^{-7} mm., and of 16NaCl about $7{\cdot}5 \times 10^{-7}$ mm.

It should be emphasised, in concluding the account of this fascinating new field of research, that all these reflections occur in the body of the crystal, and are not surface effects. Cleavage planes usually afford stronger results merely because they are generally primary planes of high reticular density. The effect is sometimes heightened by conducting the X-rays at nearly grazing incidence; but this is by no means necessary, and in Laue's experiments several of the planes were inclined as much as 30° to the incident rays.[6]

The experimental proof of the existence of the space-lattice imparts all the more confidence in approaching the other great advance which has lately been achieved. The completion of the four-volume catalogue of crystallographically measured substances by Prof. von Groth provokes the question: What more is needed in order to enable a crystallised substance described in this book to be recognised by means of a few measurements on the goniometer? For it is now proved up to the hilt that, except in the cases of cubic crystals identical in angles in accordance with their perfect symmetry, every solid crystallisable substance is characterised by its own peculiar crystalline form and interfacial angles. This is quite true, even to the last minute of angular measurement, when the conditions of crystallisation are ideal. When thus perfect, even isomorphous sub-

[5] Prof. T. W. Richards shows (*loc. cit.*) how four molecules of ZnS, each composed of an atom of zinc and an atom of sulphur of very different volumes, can form the cubic crystal unit of an edifice possessing cubic systematic symmetry, the different volumes of the two kinds of atoms causing it, however, to exhibit hemihedral class-symmetry.

[6] Since this lecture was delivered, the following further experiments with X-rays and crystals have been described in NATURE (1913, vol. xci., pp. 111, 135, and 161). H. B. Keene has obtained with crystals of galena, mica, and rock salt analogous results to those of Laue, Friedrich, and Knipping, the spot diagrams corresponding to the holohedral systematic symmetry in each case. T. Terada has found that the transmitted rays may be rendered optically visible by means of an ordinary fluorescent screen, provided the pencil of rays be from 5 to 10 mm. in diameter and the crystal adequately transparent to the rays; this latter he found to be the case with crystals of alum, borax, cane-sugar, fluorspar, mica, rock crystal, and rock salt, in thicknesses of 4 to 10 mm. M. de Broglie has obtained spot diagrams similar to those of Laue, Friedrich, and Knipping with fluorspar, magnetite (using an octahedron face), and rock salt; but all the spots were striated with parallel fringes. Finally, Owen and Blake have obtained what appears to be a line spectrum of X-rays by using the surface of a crystal of gypsum as a diffraction grating. The lines were always the same with different crystals, using the same X-ray bulb, but the different lines varied in intensity with the hardness (degree of vacuum) of the bulb. The evidence from the action of crystals on X-rays is thus accumulating that the X-rays are waves of exceedingly short wave-length.

stances show differences among themselves to the extent of a definitely measurable number of minutes. But such perfection of growth is not easy to attain, and, in ordinary crystallisation without special precaution against disturbance, is rarely found. The essential crystallographic measurements can, however, be made in an hour's time, provided use be made of the two- or three-circle form of goniometer, such as the excellent one devised by Dr. Herbert Smith. This form of goniometer enables all the needful measurements of the interfacial angles to be made with a single setting of the crystal on the wax of the holder. But practical difficulties have hitherto still stood in the way. Excellent as is von Groth's classification—and the most suitable for a work of reference of the full and comprehensive character of this permanent monument of the master's industry and wide knowledge of chemistry, related compounds being arranged and compared in close proximity—the very nature and size of such a work renders it unsuitable for the purpose of discovering rapidly the chemical composition of a substance from its geometrical elements. An index of substances arranged in the order of their symmetry and the numerical values of the crystal constants within the system is what is needed, and this has now for the first time been drawn up for the ten thousand measured substances by Prof. von Fedorow.

Another difficulty then presents itself. It often entirely depends on how a crystal is held in space, that is, which direction in it is regarded as the vertical axis, which the right-and-left axis, and which the front-and-back axis, as to what the nature of the crystal constants (elements) will be. Moreover, even if two different observers choose these similarly, they may select a different parametral plane (a fourth face other than the three faces parallel to the axes, and cutting off unit lengths from the latter) to determine the axial ratios. Hitherto, beyond a few arbitrary rules —for instance, that the right-and-left axis of a rhombic crystal shall be longer than the front-to-back axis —there has been no definite guiding principle for the determination of the setting. Prof. von Fedorow has now given us one, by means of which we can be sure which are the real vertical faces (prismatic or pinakoidal), which is the basal plane (the pair of top and bottom faces), and which set of pyramid faces are the important ones fixing the relative axial lengths. The true setting has been determined by Prof. von Fedorow for every one of the substances in his index, and the crystal elements for such setting calculated.

The mode of classification adopted in this index-catalogue is based on the values of the five fundamental angles which, in general, characterise the crystals of any specific substance. A cubic crystal has definite angles which are entirely fixed and rendered invariable by reason of the perfect symmetry. At the other extreme come triclinic crystals, the general case, in which all five fundamental angles are different and quite independent of each other. On monoclinic crystals there are three independent angles, from which the other two can be calculated. Rhombic crystals have only two independent angles, which, if measured, enable the other three to be calculated. Hexagonal, tetragonal, and trigonal crystals possess only one angle independent of the symmetry, determinative of the relative length of the unique axis of hexagonal, tetragonal, or trigonal symmetry.

The first object of von Fedorow in order to arrive at the correct setting is to decide which are the primary axial-plane and parametral faces; and he is wonderfully aided here by the discovery of the fact that the faces most extensively developed under ideal conditions of growth are those over which the points of the space-lattice are most densely strewn. Hence, von Fedorow tries to discover the faces of greatest reticular density, the primary faces, by calculation. For it is a well-known fact that the most diverse habits—due to different faces being most prominently developed under different conditions of environment—are shown by the crystals of the same substance.

Having thus determined the correct setting, and measured the principal angles, including the five fundamental angles, the results are recorded in the index-table in an abbreviated symbolic form if the substance be a new one, or, if it has previously been measured, and therefore appears in his index-table, he discovers the fact at once by the identity of the elements found with those of a substance given in the table. The average time occupied in all this by Prof. von Fedorow or one of his skilled assistants is about two hours. Mr. T. V. Barker, who studied with Prof. von Fedorow before acting as demonstrator of mineralogy at Oxford, has been of considerable help in submitting the new method to a very severe test, from which it has emerged with flying colours. He collected, at Prof. von Fedorow's suggestion, fifty specimens of substances which had been crystallographically examined in this country and described in the recognised publications. Five of these were furnished by the lecturer, six others by Prof. Armstrong, with the aid of Messrs. Colgate and Rodd, others by Drs. Chattaway and Drugman and Mr. Marsh at Oxford, and the remainder by Mr. Barker himself. Each specimen was only marked by a number, no name or formula being given, on its dispatch to St. Petersburg. The result was that Prof. von Fedorow identified without any difficulty forty-eight of the fifty substances. The crystals of one of the two others were too imperfectly developed to be of use, and the fiftieth specimen was that of a substance which it was afterwards discovered had never hitherto been measured, a fact which was first indicated by its elements not tallying with those of any substance mentioned in the table. This latter occurrence confers even greater confidence in accepting the new method.

It thus appears that in Prof. von Fedorow's hands, or those of his pupils, the method is practically infallible, provided the crystals are well developed and not of cubic symmetry. If the latter perfect symmetry be developed, reference must be made to the optical properties, which the lecturer has always insisted have been far too much neglected, and are here seen to be indispensable. The optical methods themselves, moreover, as regards their use with small crystals on the polarising microscope, have been further perfected by von Fedorow, his universal stage placing the rapid methods of two- and three-circle goniometry at the disposal of the microscopist. It must also be remembered that Prof. von Fedorow's method does not discriminate between the members of isomorphous series, as the crystals usually available are not of the high degree of perfection requisite in order clearly to substantiate the last few minutes of any particular angle; for the differences of angle between the members of series formed by metallic family analogues have been shown by the lecturer to be very minute, although unmistakable given the most perfect crystals, and have also been found to obey the law of progression according to the atomic weight of the metal. For instance, ammonium zinc sulphate was simply returned by Prof. von Fedorow as a member of the isomorphous series of monoclinic double sulphates and selenates crystallising with $6H_2O$. Qualitative analysis would be necessary after all, in order to discover the actual member of the series present. Moreover, there are certain features of Prof. von Fedorow's own peculiar version of the theory of crystal structure, such as his idea about pseudo-cubic and pseudo-hexagonal types, and his dealing in consequence with many substances as being deformations of a higher symmetry than they actually show, which to the lecturer appear unnecessary complications likely to discourage the use of the new method. But these defects can, and doubtless will, be eliminated as the method becomes practically applied. That crystallochemical analysis will ever entirely replace qualitative chemical analysis, however, is neither to be expected nor desired, even if alone on the ground of the admirable training and experience in chemical operations and principles which chemical analysis affords.

In conclusion, it must be obvious that a great advance has really now been made in crystallography. For the geometrical conception of crystals as homogeneous structures, based on the fourteen space-lattices as the grosser structures and the 230 point-systems as the ultimate atomic structures, has been not only theoretically perfected, but proved by direct experiment to represent the actual fact, by the epoch-making work of Laue, Friedrich, and Knipping. The descriptions and chemical relationships of all the ten thousand measured substances have been brought together in the great book of Prof. von Groth, and the material further sifted, reduced to correct setting, and arranged according to symmetry and elements by Prof. von Fedorow, in a tabular form immediately available as a reference index for identification purposes, thus providing the material for a true crystallochemical analysis. The science of crystallography is thus now placed on a secure foundation, supported equally by mathematics, geometry, and experiment, and its natural data are rendered available for chemists and physicists alike.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Mr. C. W. Dyson Perrins, a former member of Queen's College, has offered to give the sum of 5000*l*. towards the erection of the proposed new chemical laboratory, if such sum is required after the expenditure of the 15,000*l*. granted for the purpose by the trustees of the Oxford University Endowment Fund.

THE honorary degree of LL.D. was conferred on Mr. W. Botting Hemsley, F.R.S., on July 8 by the University of Aberdeen.

DR. W. C. MCCULLAGH LEWIS has been apppointed to the chair of physical chemistry in the University of Liverpool, in succession to Prof. F. G. Donnan, F.R.S.

THE following honorary degrees were conferred by Queen's University, Belfast, on July 9:—*D.Sc.:* Prof. Norman Collie, F.R.S.; Sir Joseph Larmor, M.P., F.R.S.; Sir Arthur Rücker, F.R.S. *LL.D.:* Sir Donald MacAlister.

AMONG the bequests of the late Lord Avebury is one of 1000*l*. to the University of London to found a prize in mathematics or astronomy in memory of his father, Sir John William Lubbock, first Vice-Chancellor of the University.

DR. J. RITCHIE, superintendent of the laboratory of the Royal College of Physicians, Edinburgh, has been appointed to the new chair of bacteriology instituted in the University of Edinburgh, under the bequest of Mr. Robert Irvine, Royston, Granton.

AMONG recent appointments at University College, London, are:—Dr. Marie Stopes, lecturer in palæobotany for three years; Miss Winifred Smith, lecturer in taxonomy for three years; Dr. Paul Haas, demonstrator in organic and applied chemistry and in chemical physiology, and Mr. H. Terrey, demonstrator in chemistry to medical students; Mr. N. F. Kelsey, demonstrator in mechanical engineering, and Mr. D. W. Fletcher in graphics.

THE following official announcement referring to the Education Bill has been issued on behalf of the Government:—"The measure which will shortly be introduced by Mr. Pease in the House of Commons, although it is technically described as an Education Bill, is in reality only a one-clause measure designed to enable the Government to afford a limited amount of immediate relief to education authorities. It will, when introduced next week, form a not inappropriate peg upon which to hang a statement of the Government's policy in the development of a national system of education."

AT the annual graduation ceremony at St. Andrews University on July 10 honorary degrees of LL.D. were conferred on Lieut.-Col. Sir C. H. Bedford and Dr. G. A. Boulenger, F.R.S., among others. In addressing the graduates the principal, Sir James Donaldson, said that both France and Germany have come gradually to form an exact notion in regard to university work. Their idea is that after the culture obtained in the secondary schools the students who are to proceed to degrees should spend three years at the university and should devote themselves to the original study of certain subjects in which they find their interest. There must be entire freedom for the student to form his own plans and studies and entire freedom for the professor to search for the truth for its own sake in disregard to consequences. The Germans have kept to that idea since 1815, and the French have now come to the same conclusions. We are in many respects far behind this ideal, and we cannot expect to be a match for those nations in the great conflicts of the world, but it is the duty of young and old to look into the question, particularly at this time, and see if we cannot do something to put ourselves on an equality with Germany and France.

THE recommendations made in the second report of the Advisory Committee on the distribution of Exchequer grants to universities and university colleges, which was issued last February, having been approved by the Board of Education, the Committee proceeded with a further consideration, in conjunction with the universities and colleges, of the federated superannuation scheme adumbrated in the second report. In its third report the committee outlines a federated scheme of superannuation for professors and other members of the staffs of colleges. Two problems were debated; first, the selection of a limited number of insurance companies to undertake the contracts involved by the superannuation system; and secondly, the drafting of a suitable form of legal agreement between the institution and the members of the staff which when adopted by colleges concerned would give practical effect to the principles set out in the second report. The form of agreement indicates, by means of alternative readings, the various forms which will be necessary to meet different cases. In practice institutions will probably find it convenient to have separate forms of agreement to meet different types of cases. The superannuation scheme itself expresses in legal terminology the principles outlined in the second report, and in order to secure interchangeability it seems essential, the third report points out, that this part of the legal document should be adopted without amendment by every institution cooperating in the system. A pamphlet has been prepared setting out the main features of the options available and the precise terms offered by the selected insurance companies; it also embodies the detailed arrangements with the companies, and copies will be furnished on request by the companies concerned.

FROM time to time attention has been directed in these columns to the recent successful endeavours to develop the University of Hong Kong. The prospectus for the session 1913–14, and a pamphlet providing details concerning the faculty of engineering, have reached us, and an examination of the arrangements made shows that there is likely to be much useful work done in the next few years in the spread of higher scientific education in China. A resolution adopted by the Court of the University says: "It is resolved that the objects of the University are (*inter alia*) to afford a higher education, more especially in subjects of practical utility, such as applied science, medicine, &c. Similarly, in a dispatch from the Viceroy of Canton, we read "the teaching of applied science, including civil, mechanical, and electrical engineering and surveying, meets the present and most urgent need of our country." The University possesses spacious laboratories for experimental work and is assured already of excellent equipment. In the first year of the University fifty-three students applied for admission in the faculties of engineering, medicine, and arts, and of that number thirty-eight elected to take instruction in engineering. When the University commenced instruction in engineering science it was stated definitely that no student would receive a degree unless he attained the same standard as that required by the London University. To that policy the faculty of engineering is committed, and the regulations have been framed with that object in view.

THE eighth report has been published (Cd. 6871) of the Rural Education Conference, which was constituted by minutes of the Presidents of the Board of Agriculture and Fisheries and of the Board of Education in 1910. The conference has had under consideration the following reference received from the Board of Agriculture and Fisheries last November:—"To inquire into the methods which local education authorities adopt with the object of promoting efficiency in the performance of manual processes, *e.g.* ploughing, hedging, ditching, sheep-shearing, milking, and basket-making, and to advise as to any further action that may appear to be desirable for the purpose of developing skill in workmen employed in agriculture." After the examination of eleven expert witnesses representing farmers and educationists, the conference drew up a number of recommendations which may be summarised very briefly. To develop skill in agricultural employees it is recommended that instruction in certain manual processes of agriculture should be provided for the elder boys and girls attending elementary schools in rural districts; local education authorities should regulate the holidays in country schools so as to leave the boys free to work on the land at a time when their work is most useful; classes in manual processes for men employed upon the land should be conducted so as to be more in the nature of assistance to, rather than the formal instruction of, those who attend; instruction in manual processes should be provided more generally throughout the country, present instruction should be made more thorough, and practical instruction be encouraged in every possible way.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 7.—M. F. Guyon in the chair.—Paul **Appell**: Developments in series proceeding according to the inverse of given polynomials.—J. **Boussinesq**: The equations of dynamic equilibrium of the superficial layer separating a liquid from another fluid.—A. **Lacroix**: The rhyolitic and dacitic rocks of Madagascar, and in particular those of the Sakalave region. Complete analyses of twenty-one rocks are given, and the distribution of the rocks in the area discussed.—A. **Müntz** and E. **Lainé**: Studies on the irrigation of soils. The minimum irrigation gives the best cultural results; it depends on the slope of the land, the nature of the vegetation, and the dimensions of the distributing channels.—G. **Charpy** was elected a correspondant for the section of chemistry in the place of the late Louis Henry.—Ch. **Platrier**: Meromorph solutions of certain linear integral equations of the third species.—M. **Barré**: Helicoids of the second species.—Th. **Got**: The symmetries of the reproductive groups of indefinite ternary quadratic forms.—A. **Romieux**: Contribution to the study of the terrestrial deformation.—C. G. **Bedreag**: Electrification by the X-rays. The charge depends on the pressure, the nature of the metal of the electrode, difference of contact potential between the electrode and the surrounding walls, and ionisation of the gas. In the present communication a special study is made of the function of the metal. André **Chéron**: A new arrangement for the examination of stereoscopic photographs.—Henri **Labrouste**: The visibility of traces of foreign substances deposited on a surface of pure water. The method described permits of the thin layers being detected by optical means without the use of any special apparatus. Mlle. Cécile **Spielrein**: The equilibrium of lithium sulphate with the alkaline sulphates in presence of their mixed solution at 100° C.—Ruby **Wallach**: The thermal analysis of clays. The double galvanometer of Le Chatelier-Saladin with a thermocouple was applied to the examination of various kaolins and clays, the heat absorption due to the volatilisation of water being shown by well-marked depressions on the curve. A slight heat evolution between 900° C. and 1000° C. was also observed in some cases, an effect probably due to a transformation of alumina.—André **Job** and Paul **Goissedet**: The cerium acetylacetonates. Ceric acetylacetonate has been prepared and analysed.—M. **Dumesnil**: Diketones obtained by the action of the xylylene dibromides on the sodium derivative of *iso*-propylphenylketone and their decomposition by means of sodium amide. Roger **Douris**: The addition of hydrogen to some secondary α-ethylenic alcohols in presence of nickel.—Marcel **Baudouin** and Louis **Reutter**: The analysis of the contents of some Gallo-Roman vases and of a flask of perfume, found in a vault at la Vendée. These vases date probably from the third century. Styrax, turpentine, resin, asphalt, or Judean bitumen, and incense were found. These prove indirectly the existence of commercial relations between France and Asia Minor, Somaliland and Judea.—J. **Durand**: A layer of aragonite crystals in the marls attributed to the Upper Trias in eastern Corbières.—C. **Gaudefroy**: The dehydration figures of different types obtained in the same crystals.—A. **Guilliermond**: The rôle of the chondriome in the elaboration of the reserve products in fungi.—A. **Marie** and Léon **MacAuliffe**: The anthropometric study of 200 Madagascans.—E. **Gley** and Alf. **Quinquaud**: The influence of the suprarenal secretion on the vasomotive actions dependent on the splanchnic nerve.—A. **Barbieri**: The difference in chemical composition between the great sympathetic system and the axial nervous tissue of the cranial and spinal nerves.—E. **Bourquelot** and M. **Bridel**: The synthesis of β-geranyl-glucoside with the aid of emulsin; its presence in plants. The glucoside can be synthetised from geraniol saturated with water and glucose in presence of emulsin; a larger yield is obtained in aqueous acetone solution. The presence of this glucoside was proved in *Pelargonium odoratissimum*.—P. Noël **Bernard** and J. **Bauche**: The influence of the mode of penetration (cutaneous or buccal) of *Stephanurus dentatus* on the localisations of this Nematod in the organism of the pig and on its evolution.—E. **Pinoy**: The necessity of a bacterial association for the development of a Myxobacterium, *Chondromyces crocatus*.—F. **Picard** and G. R. **Blanc**: Coccobacillary infections in insects.—F. **Kerforne**: The Devonian iron minerals of Brittany.—Antonin **Lanquine**: The presence of layers containing Witchellia, of the lower Bajocian, at some new points of the Var.—Alfred **Angot**: A new barometric formula. The barometric formula communicated to the last meeting is equivalent to Babinet's formula. The latter in its original form is more easy to memorise.—Ladislas **Gorczynski**: The reduction in the solar radiation for 1912 from pyrheliometric measurements made in Poland.

BOOKS RECEIVED.

Some Secrets of Nature. With an Introduction by W. J. P. Burton. Pp. xiv+144+plates. (London: Methuen and Co., Ltd.)

The Romance of Nature. A Nature Reader for Senior Scholars. With a Preface by Rev. A. Thornley. Pp. xix+164+x plates. (London: Methuen and Co., Ltd.) 2*s*.

Démonstration du Théorème de Fermat. By Prof. E. Fabry. Pp. 22. (Paris: Hermann et Fils.) 1.50 francs.

Grundriss der Fermentmethoden. By Prof. J. Wohlgemuth. Pp. ix+355. (Berlin: J. Springer.) 10 marks.

Petrographische Untersuchungen an Gesteinen des Polzengebietes in Nord-Böhmen. Des xxxii. Bandes. Der Abhandlungen der Mathematisch-Physischen Klasse. No. VII. By K. H. Scheumann. Pp. vi+607–776. (Leipzig: B. G. Teubner.) 8 marks.

Memoirs of the Geological Survey of India. Vol. xl. Part 1. The Oil-Fields of Burma. By E. H. Pascoe. Pp. x+269+xxxix+54 plates. (Calcutta: Geological Survey of India; London: Kegan Paul and Co., Ltd.) 5 rupees, or 6*s*. 8*d*.

Les Idées Modernes sur la Constitution de la Matière. Conférences Faites en 1912. By E. Bauer, A. Blanc, E. Bloch, Mme. P. Curie, A. Debierne, and others. Pp. 370. (Paris: Gauthier-Villars.) 12 francs.

Les Moteurs Thermiques dans leurs rapports avec la Thermodynamique. Moteurs à explosion et à Combustion. Machines alternatives a Vapeur. By F. Moritz. Pp. vi+297. (Paris: Gauthier-Villars.) 13 francs.

Proceedings of the Third Meeting of the General Malaria Committee held at Madras, November 18, 19, and 20, 1912. Pp. iv+289. (Simla: Government Central Branch Press.)

The Tarn and the Lake: Thoughts on Life in the Italian Renaissance. By C. J. Holmes. Pp. x+48. (London: P. Lee Warner.) 2*s*. 6*d*. net.

The British Parasitic Copepoda. By T. Scott and A. Scott. Vol. i. Text. Pp. ix+252+2 plates. Vol. ii. Plates. Pp. xii+lxxii plates. (London: The Ray Society; Dulau and Co., Ltd.) 15*s*. net.

Das Tierreich. Edited by F. E. Schulze. Lief. 34 to 38. (Berlin: R. Friedländer und Sohn.) 18 marks; 38 marks; 13 marks; 3.50 marks; 5.20 marks respectively.

Animal Husbandry for Schools. By Prof. M. W. Harper. Pp. xxii+409. (London: Macmillan and Co., Ltd.) 6*s*. net.

The Development of the Human Body. By Prof. J. P. McMurrich. Fourth edition. Pp. x+495. (London: H. Kimpton.) 12*s*. 6*d*. net.

Die Europaeischen Schlangen. By Dr. F. Steinheil. Zweites Heft. Plates 6–10. (Jena: G. Fischer.) 3 marks.

Sitzungsberichte der Physikalisch-medizinischen Sozietät in Erlangen. 44 Band. 1912. Pp. xxvii+256. (Erlangen: M. Mencke.)

Irritability: a Physiological Analysis of the General Effect of Stimuli in Living Substance. By Prof. Max Verworn. Pp. xii+264. (New Haven, Conn.: Yale University Press; London: Oxford University Press.) 15*s*. net.

Travers' Golf Book. By J. D. Travers. Pp. 232. (London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

Palæontologische Zeitschrift. Edited by Prof. O. Jaekel. Band I. Heft 1. Pp. 160+3 plates. (Berlin: Gebruder Borntraeger.) 25 marks.

The Eugenics Education Society. Fifth Annual Report, 1912–13. Pp. 76. (London: Kingsway House, Kingsway.)

A History of the First Half-Century of the National Academy of Sciences, 1863–1913. Pp. ix+399+plates. (Washington: The National Academy of Sciences.)

Department of Commerce and Labor. The Foreign Commerce and Navigation of the United States for the Year ending June 30, 1912. Pp. 1342. (Washington: Government Printing Office.)

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Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, JULY 24, 1913.

CAMBRIDGE IN THE NINETEENTH CENTURY.

"J.": a Memoir of John Willis Clark. By A. E. Shipley. Pp. x + 362. (London: Smith, Elder and Co., 1913.) Price 10*s.* 6*d.* net.

TO anyone who had a share in Cambridge life in the latter half of the century that closed with 1910, J. W. Clark, either as superintendent of museums or as registrary, was a familiar and striking figure. The many who knew him intimately called him "J.," and all will welcome the biography with that title which the Master of Christ's, in more ways than one "J.'s" successor, has produced with the assistance of a number of friends. The book itself is rather gossipy. "We respected him as a man of learning and weight, and still more as a man of the world," says one of the contributors; and it is largely with "J." as a man of the world that the book deals. From the point of view of the casual reader, it reminds one somehow of the hundred and nineteenth psalm. The kaleidoscope is shaken through some 300 pages, but the same constituent elements occur on every page: "J.'s" friendliness, waywardness, temper, as well as his interest in society, travel, theatres, museums, buildings, architecture, books and libraries; and the serious part of the book, which deals with the development of the study of the natural sciences at Cambridge, finds accommodation in two appendices. But, by the same token, those who read the book with some knowledge of local colour will find it an epitome of Cambridge in the nineteenth century, opportunist, casual of purpose, wayward, but effective and progressive.

Look at the beginnings. "J.'s" father, William Clark, the second son of a Newcastle doctor, was sent to Trinity in 1804, became a scholar in 1807, seventh wrangler in 1808, fellow of Trinity in 1809, "having especially impressed the examiners by a brilliant rendering of a passage of Pindar into English verse." He "walked the hospitals" in London, was admitted to holy orders, and at the age of twenty-six became a candidate for the "professorship of anatomy." The election was *more burgensium.* Lord Byron was a distinguished supporter. Clark failed on the first occasion, but succeeded later, and became professor of anatomy in the University at the age of twenty-nine—a fine instance of casualness of purpose, waywardness, and effectiveness on the part of the University.

At that time the domination of the colleges over the University was complete. The heads of the seventeen colleges were the governing body; pairs of colleges took it in turn to "police" the undergraduates, and to examine them all for their degrees. The head was "the only permanent officer of the college"; indeed, the other offices were mostly held at his pleasure. It is a common misunderstanding to suppose that the matrimonial restriction operated to prevent fellows marrying; its real effect was to restrict the college appointments to what would now strike us as extreme youth. A few confirmed bachelors who had taken holy orders lingered on in residence, and sometimes even attained old age, but they soon became superannuated for college work and fossilised. Lecturers were often Bachelors of Arts, and an appointed tutor has had to wait for the completion of his M.A. degree before he could fufil all his functions. Veritable history speaks of a college don who, having passed through all the range of college offices, was regarded as quite past work, and only waiting until it should please Providence to call him to his rest, and who, on inquiry, proved to have attained the ripe age of thirty-five years. He is, however, still in this world of care, again enjoying a well-earned rest, though he has some thirty years of service in a country living to add to the record which forty years ago was regarded as complete.

Thus when "J.'s" father took up the duties of professor of anatomy, the permanent staff of the University and colleges made up a small and select society of seventeen heads and twenty-five professors, with a registrary and librarian, three bedells, and eleven "cormorants," members of the senate *commorantes in villa.* The selectness and closeness of that society are still the subject of many Cambridge anecdotes, some of which are included in "J.'s" charming reminiscences, reprinted from the *Cambridge Review,* in the volume before us; but what is forgotten is that there must have been a yawning gulf of age between the average college don and the permanent society which, as years went by, had necessarily to rely more and more upon its dignity rather than its activity for the respect of the rising generation. The social amenities of college life naturally remained mediæval, and to a certain extent they are so yet. It is still an accepted principle that the simple labour of the bedmaker is to be preferred to the devious machinations of the plumber for carrying bath-water to and fro.

Into this close society "J." was born in 1833, with one of the twenty-five professors as father, and another, Robert Willis, as uncle; the biography does not say what he thought of professorships, but he never developed that respect for headships of colleges which continues to be the keystone of the structure of Cambridge society.

He was sent to Eton, where he was not very happy, and then passed on to Trinity. As an undergraduate he wrote with characteristic exaggeration: "Really, I cannot but think it quite monstrous that everyone is to waste four-and-twenty years of their life in learning two dead languages which can never be of the slightest use to them"; but he obtained a place in the first class of the Classical Tripos in 1856, and his exertions were rewarded by a fellowship in 1858. Vacancies were not so scarce then as they are now; the average tenure was, no doubt, much shorter. "I never ought to have got a fellowship, but there happened to be eight vacant that year, and they gave me one."

It was the same all through his life—things happened. After obtaining his fellowship, he proceeded to amuse himself with foreign travel and otherwise. "He took an active part . . . especially in the A.D.C.," and so he became for many years stage-manager of the University for dons and men, and the drama was his hobby. When his fellowship lapsed, in 1866, he retained his rooms in Trinity because he was supposed to be engaged upon the college records, and he was deputy junior bursar in charge of the buildings, and deputy librarian in charge of the books. He only returned the muniments which gave him a title to rooms, duly "calendared," forty-four years later, but he soon became the leading authority on college buildings and the care of books. His father included comparative anatomy in the subject which he professed, and collected specimens in illustration. When he grew old, his classical son helped with the "museum," and so, when his father resigned, became superintendent of the Museum of Comparative Anatomy, while human anatomy went to G. M. Humphry, and a new professorship of zoology was created. The attitude of the new professor to the Museum of Zoology and Comparative Anatomy is characteristic of himself and of one side of Cambridge.

"The prevalent belief, I take it to be, is that the professor of zoology ought to look after the museum. I need not say how absurd this is. . . . One notion that underlies it all is that your salary (!) may be saved to the University, which, of course, is false, because I should never, under any circumstances, take on me such additional duties without an equivalent."

The appointment as superintendent and the lapse of his fellowship, since "J." was not in "orders," occurred in the same year; and, at the same time, he became a member of the newly formed Museums and Lecture Rooms Syndicate, and later he became secretary. The history of this syndicate, now at an end, is neither more nor less than the history of the development of the study of the natural sciences in Cambridge, and it nearly all "happened" while "J." was secretary. How it all happened, perhaps no one can say; new statutes and a Royal Commission, a few far-sighted dons, and private benefactors had something to with it, but "J.," without professing anything, or being what one could call a don, was there all the time, a sort of nucleus for growth. That "J." was a Trinity man goes without saying, but, perhaps more than anyone else, he stood for the University as distinguished from the colleges. Of his college he became auditor, a sort of external guardian, but of the University he was so much a part that the statutory offices of librarian and registrary, for which the colleges had never claimed a right in rotation, seemed his own. Popular election gave him the latter in 1891, and in that he served the University until close upon his death in 1910.

In 1873, when his position in Cambridge was established, "J." happened to propose to, and marry, Miss Frances Matilda Buchanan, whose father was at the time British Ambassador at Vienna. According to his biographer, this was the best thing he ever did, and certainly he owed to it no small part of his success as a man of the world. The book abounds with stories and letters of affectionate family life, of deep and lasting friendships, and of unconstrained sociability with all men of proper tone, quite irrespective of age or academic standing. "J." was a very helpful friend, but he never patronised.

Thus "J." made the most of a very fortunate opportunism; he never set out deliberately to be a zoologist, or a man of books, or an archæologist, and he certainly did not try to be a social success; yet he was all these things because they came in his way.

How like to his University! While "J." lived his life, Cambridge, out of the rivalry of her colleges, developed from her "tripos" a scheme of examination which has overspread the Civil Service and the whole educational system of the country, without any more motive than to "doe the nexte thyng." It has somehow added study to study, laboratory to laboratory, museum to museum until it has obtained a magnificent establishment for the University, as distinct from the colleges, and the old close society has become absorbed in a larger life. Those who remember the material provision which the University had in the early 'seventies for Maxwell, Stokes, Foster, Liveing, Dewar, and compare it with the scientific palaces that are now to be found there.

about, will naturally look for some well-laid scheme for fostering all the subjects that are called scientific. They will find something *à propos* in the action of the Commissioners of 1877; but, so far as the spontaneous action of the University is concerned, it is all very much "as it happened." Other universities may set out to rear proconsuls, and succeed therein, but Cambridge leaves her actions to define her ambitions. If she prepares for nothing, there is nothing which she is not prepared for, if only opportunity offers.

Like "J.," if there are museums to be tended, she is a zoologist; if there are books to be cared for, she learns about libraries; if there are buildings to think about, she is an archæologist, or at least an architect. One is reminded of the person whom Mark Twain once set to music in words like these:—

> Whate'er this man is sot to do
> He'll do it with a zest;
> No matter what his training is,
> He'll do his level best.

There are, indeed, few things in this world that the well-trained Cambridge man has no opinion about; he generally knows at least how they ought to be done. A few weeks ago a typical Cambridge man, confronted for the first time with an elaborate contrivance, the result of years of effort, for eliciting some of the secrets of nature, gave expression to his admiration by suggesting that it was probably based upon an erroneous principle. The danger of the Cambridge opportunism is that the opportunity of doing the same things over again, but, of course, better, is such a tempting by-path leading away from the object for which the things are done at all.

The Cambridge man has the examiner's instinct in his bones; he is so accustomed to examining everything that his first impulse is to assign marks —but not too many. "I should give 75 per cent. for the sort of answer I would have written myself," as a colleague examiner once said. It may be that, in the same way, the instinct of the sister university, on being confronted with a new fact, would be to write an essay about it (which might come in useful sometimes), but Cambridge still holds by "Mr. Tripos," and cannot help beginning the consideration of any subject by a "nego majorem," if possible.

One ought not to omit the biography of Sedgwick, written in conjunction with Prof. McKenny Hughes, but "J.'s" chief contributions to our knowledge were his four monumental volumes of the architectural history of the University and colleges of Cambridge, begun by his uncle, Robert Willis, his dramatic work, and his numerous books and pamphlets on libraries and the care of books, while his ostensible business in life was the Museum of Zoology and Comparative Anatomy. According to his own account, had Frank Balfour lived, he would have devoted himself to science, but, unfortunately, Balfour perished. Here, again, through him we see his University. With its seventeen colleges it now includes a vast staff of persons of the highest competence, whose ostensible duties are to teach, but how many of them become known to fame for their teaching? One hears more often of their attaining eminence as "good business men," and, indeed, the curious art of expert management of affairs by unpaid syndics seems likely to overspread the land like the examination idea. Perhaps Rhodes might have had some opinion on the subject; he might have thought, with some justice, that the syndic was apt to take out his value in time, as there was no question of money. It may be either pious or profane to say it, but in its indirectness of purpose Cambridge is distinguished from the great world outside, and the Cambridge man is apt to carry with him the opportunist idea which abounds on the Cam, that his chance of distinction lies in making and using opportunities to do something else.

Dear "J."; one wonders what he would have said at his biography being made a spyglass to look at his University with; something forcible, no doubt, if not polite. It was not any sublime absence of human failings that endeared "J." to successive generations of Cambridge men. His jaunty walk, the suggestion of being on good terms with himself and all the world, the air of possession when some purpose happened to have become his own, and the natural conclusions to be drawn from the fact that, whatever happens, one has to dine somewhere, made his society a real addition to the joy of life.

And, after all, if one takes out "J.," and writes Cambridge instead, there would be nothing much to alter. Alma Mater Carissima! you are provokingly irresistible. How can we but adore you when, in reply to the suggestion that with a scheduled income of some 300,000*l.* a year you might easily present the magnificent spectacle of a self-governed world speeding onward towards the light, you say (and really think), "Tut-tut—it's all a misunderstanding; we are really seventeen sisters and a mother, old and very poor, as poor as can be, especially the mother." *Hinc lucem et pocula sacra!* yet you are very human, and by taking advantage of this opportunity and that, you have surely moved onward in the last century more than any of your sons would have thought possible.

To the presbyopic eye, looking backward over the dim years, it seems that it must have been the people of "J.'s" type in Cambridge who have really counted in the revolution of the nineteenth century. "All the world's a stage," and a born stage-manager has, perhaps, as much to do with the success of a play as the "stars" themselves.

THE FLEUR-DE-LYS.

The Genus Iris. By W. R. Dykes. With Forty-seven Coloured Drawings by F. H. Round, One Coloured Plate of Seeds by Miss R. M. Cardew, and Thirty Line Drawings by C. W. Johnson. Pp. 245. (Cambridge University Press, 1913.) Price 6*l*. 6*s*. net.

NO more fitting tribute could have been prepared to the memory of Sir Michael Foster than a monograph of the group of plants he loved so well and studied with so deep an interest, and the volume produced by Mr. Dykes would without doubt have evoked Sir Michael's warmest approbation.

The genus Iris, like Crocus and so many other monocotyledonous genera, offers a particularly fascinating field of study from the beauty of form and colour displayed and the remarkable diversity of the species. Mr. Dykes is to be congratulated in having cultivated the majority of the species in his own garden, and with such success that the illustrations, with but one exception, have been prepared from the plants grown by him at Godalming. These illustrations, by Mr. F. H. Round, are elegant works of art which have been very faithfully reproduced in colour, and form a valuable addition to the volume. The Cambridge Press deserves a special mention in this connection, both for the beauty of the plates and for the style in which the monograph has been published.

Mr. Dykes has spared himself no pains in searching English, Continental, and American herbaria for his material, and, in particular, Kew, with its herbarium and library, proved to be a mine of wealth. He has wisely studied the type specimens with the original descriptions of all the "species" of Iris, and has thereby been able to arrive at a definite idea as to the actual number of such "species" as are really worthy of specific rank. By ignoring the records of species in local floras, unless they could be verified by actual specimens, Mr. Dykes may have left some gaps in the distribution tables of some of the species, but he has certainly avoided many possible sources of error.

Irises are not only plants of interest to the gardener, but they are also of interest to the plant-breeder for the facility with which they may be hybridised. In this direction the late Sir Michael Foster was, of course, an expert, and the hybrids he produced were always a source of the keenest pleasure to him.

In addition to the ease with which hybridisation may be effected, variation is also characteristic of many species, and it is owing to this tendency that so much confusion as to the limits of species has arisen. Mr. Dykes has constant occasion to allude to this fact, for not only do the plants vary in their wild state, but they show themselves particularly prone to manifest variations under cultivation. Mr. Dykes, however, has been in no hurry to rush to conclusions, but has taken time thoroughly to digest the mass of material which he has studied, and botanists, we feel sure, will agree that they owe him a deep debt of gratitude for the sound and careful work he has done.

The early pages of the monograph are occupied by general matter dealing with the literature of the iris, structure, distribution, and cultivation, followed by outlines of the different sections of the genus. The species are then described very fully under their respective sections, with full citations of specimens and detailed setting-out of their geographical distribution, followed by useful notes on the affinities of each species.

It is not possible to attempt any criticism of this the essential part of the book, and its merits can only be adequately realised by one working over the material. It may, however, safely be said that Mr. Dykes has produced a work with much care and sound judgment, the value of which will increase as years pass by.

THE CHEMISTRY OF FATS AND ALLIED SUBSTANCES.

Chemie der Fette, Lipoide und Wachsarten. By Dr. W. Glikin. Erster Band: pp. xvi + 789; Zweiter Band: pp. xi + 788. (Leipzig: Gebrüder Borntraeger, 1913.) Price, 2 vols., 72 marks.

A NOTABLE feature of this work is the amount of consideration given to the physiological chemistry of the fats, and to the general chemistry of the lipoids. The question of the origin of fat in the animal body is of much interest and importance; and in the earlier chapters of the first volume Dr. Glikin gives an account of the experimental evidence on which arguments have been based to show that the fat of the animal body may be produced from fat ingested as food, or elaborated from proteid substances, or from carbohydrates. Doubtless the accounts of the experiments are often ancient history, going back, as they do, to researches of Hoppe-Seyler in 1859, of Pettenkofer and Voigt in 1869, and to various controversies in subsequent years. They serve, however, to give a connected survey of the whole matter.

The lipoids, it should perhaps be mentioned, are substances more or less closely associated with the fats, and extractible by organic solvents from various parts of animals and plants. Some—the phosphatides—contain both phosphorus and nitrogen; others contain nitrogen, but not phosphorus; others, again, contain neither of these elements. They are of much physiological importance, and during recent years have been much studied by Windaus, Diels and Abderhalden, Cousin, Rosenheim, and other workers. Cholesterol, phytosterol, lecithin, and cerebrin may be mentioned as some of the best-known representatives of the group. The author gives a full description of this class of substances and their compounds, though he regrets that lack of space prevents his discussing the behaviour of lecithin under hæmolysis.

The general chemistry of the fats and waxes is treated at considerable length. Besides the usual descriptions of the acids, alcohols, and glycerides which compose the oils, fats, and waxes, the text includes discussions of the constitution of some of the principal fatty acids, and of the properties of their salts and other compounds.

The remainder of the first volume is devoted to a description of the methods in vogue for the analysis of oils, fats, and waxes. An alphabetical order is adopted in tabulating the various physical and chemical data; this plan is convenient for ascertaining the characteristics of a known oil or fat, but for help in classifying an unknown article it might well be supplemented by a table arranged according to the values of the iodine number.

In the second volume the preparation and examination of the individual oils, fats, and waxes are dealt with. For each article an outline of its origin, method of preparation, and properties is given, followed by tables of the physical and chemical constants appertaining to the substance and to the fatty acids separable from it. The closing chapters are concerned with various manufactures allied to the fat industry, such as the making of soap, varnish, glycerin, and stearin.

The author's aim has been to produce a connected treatment of the whole subject, and his book is probably the most complete work of the kind yet published. C. S.

OUR BOOKSHELF.

Weights and Measures Act, 1904. Board of Trade Notices Annotated. By H. Cunliffe and G. A. Owen. Vol. i. Pp. viii+199. (Smethwick: H. Cunliffe, 1913.) Price 5*s*. net.

This work is intended for inspectors and others interested in the administration of the Weights and Measures Acts. Under the Act of 1904 the Board of Trade was empowered to examine as regards material and principle of construction such patterns of weights, measures, weighing or measuring instruments as might be submitted to it, and to issue certificates in cases where the patterns were found not to facilitate fraud. From time to time the Board issues notices setting forth its decisions with respect to such submissions, and the writers of the present volume have collected together the first fifty of these notices and publish them with criticisms and explanatory notes.

The authors are inspectors of weights and measures of considerable experience, and their book appears likely to be useful to persons preparing for the Board of Trade examination for certificates of qualification as inspectors, as well as to such acting inspectors as may find difficulty in identifying patterns from the information given in the Board of Trade notices. It is usual for the inspectors' examination to include a question requiring a description of the functions of the various parts of a pattern illustrated in one of the notices, but owing to the fact that some of the patterns represent instruments which have never been put on the market, or are in very restricted use, such information is rather difficult for a candidate to obtain.

The descriptive letterpress which accompanies the notices in this work is very complete, the annotations and detailed explanations as regards the various weighing instruments considered being particularly good. A few blemishes are noticeable here and there: for example, there is an omission on p. 6 in the citation of section 5 (*a*) of the Act, which renders some of the remarks on p. 8 not readily intelligible. The interpretation of instruction 35 given on p. 12 is forced and misleading. On the whole, however, the work appears to have been prepared with great care. The authors propose to deal with later issues of the notices in a subsequent volume.

Text-book of Zoology. By H. G. Wells and A. M. Davies. Sixth edition. Revised by J. T. Cunningham. Pp. viii+487. (London: W. B. Clive, University Tutorial Press, Ltd., 1913.) Price 6*s*. 6*d*.

The supplement which Mr. Cunningham added to the fifth edition of this popular text-book has now been incorporated in the body of the work, and the section dealing with the Invertebrata has been rearranged so that the types follow in general the descending order in classification. Important additions have been made explaining the facts and theories of most importance to modern biologists in relation to the problems of evolution.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

"Cheiropleuria bicuspis" (Bl.) Pr.

Through the influence of the Rajah of Sarawak and the activity of the director of the museum there, to both of whom my grateful thanks are due, I have recently received an ample supply of specimens, dried and preserved in alcohol, of the uncommon Malayan fern, *Cheiropleuria bicuspis* (Bl.) Pr. As some considerable time must elapse before its details can be worked out, I think it will be well to state briefly certain points of interest in relation to it.

The creeping rhizome, which is covered with hairs, not scales, bears long petiolate leaves at intervals, which are variable in the form of the lamina. Some, especially those of the smaller plants, have an ovate acuminate outline, others may be two- or three-cusped, or in large plants the number of lobes may be four or five. In these cases there is an obvious bifurcation of the lamina, a point well shown in Sir W. Hooker's illustration of the species, quoted as Fig. 175 in Engler, u. Prantl., i., 4, p. 337. The relation of the leaf and its venation to that of Dipteris is very marked in the larger examples. There can be no doubt that the nearest affinity of Cheiropleuria is with the Matonineæ.

The fertile leaves appear to be always simple, and of narrow form. Their lower surface is covered by a dense mass of sporangia and hairs, in an Acrostichoid manner. The sporangia themselves have an oblique annulus, and the various ages of them are intermixed.

As against these rather advanced characters, the anatomy presents surprising features of simplicity. The rhizome appears in the Bornean specimens to be constantly protostelic, with much parenchyma, not solenostelic, as stated by Christ ("Farnkraüter," p. 128). The leaf-trace comes off as a single mesoxylic strand, which soon opens out and becomes semilunar, and then divides into two equal strands. These characters indicate, on one hand, a greater similarity to Mertensia in the mature stock than is shown by any Matonioid fern; on the other an advance on Matonia and Dipteris, both in the anatomical and the soral condition of the leaf. The effect of these facts upon the comparative position will be, on one hand, to strengthen the relation of the Matonioid series to the Gleicheniaceæ; on the other, to illustrate a further step in advance in foliar character than any of them show. The relation to Platycerium has been definitely indicated by Diels ("Naturl. Pflanzenfam.," i., 4, p. 336). It will remain for more detailed inquiry into the structure and development of both of these genera to show how far Cheiropleuria approaches Platycerium. Conclusions on this point must be deferred for the present, though certain facts appear provisionally to support such an alliance.

F. O. Bower.

Botanical Department, University of Glasgow,
July 18.

Cupriferous Sandstones at Exmouth.

Observations made last winter upon the lithological characters of the Red Marls, with intercalated sandstones, exposed in the cliff-section running eastwards from Exmouth towards Straight Point, disclosed some interesting facts which may serve to remove doubts as to these rocks having been formed under conditions contemporaneous with, and similar to, those prevailing during the deposition of the German Rothligendes in Permian times.

The sandstones consist of very smooth and rounded grains of quartz, and what appears to be cornelian, together with copper and manganese, consolidated by a calcareous and dolomitic cement. The copper occurs as a green carbonate derived from the decomposition of minute particles of copper pyrites present in the rock. Vivid green patches and specks of this copper carbonate are very conspicuous on the surfaces of bedding-planes and other places where water has percolated freely. Mr. F. Southerden, of the University College, Exeter, kindly analysed some of the specimens, and an average sample yielded about 1 per cent., and a richer specimen more than 3 per cent., of the carbonate. None was found in any of the marl, nor in the *red* sandstones of Rodney and Orcombe Points.

The manganese is very widely distributed, both in the red and the buff sandstones, as minute black specks, frequently rudely dendritic in arrangement, and as films coating the grains of quartz. Occasionally large areas become quite black with it. Where copper is present manganese is always present also, but manganese is frequently present without the association of copper.

The grains of quartz composing the bulk of the sandstone are remarkable for their roundness and smooth surfaces. Much research in reference to sands leads me to believe that they were originally rounded by wind action, and subsequently polished by water holding finer matter in suspension. The natural disintegration of this type of sandstone produces a sand which, when sifted by wind and wave on the sea-beach, should be musical, but it was not until May last, after many visits, that I found several very musical patches on the beach between Rodney and Orcombe Points, and also under the "High Lands of Orcombe."

In places along the foot of the cliffs the lime in the cliff-springs cements the beach material into solid masses of sandstone and conglomerate, and dry sand, blown from the beach against wet places on the cliff-surfaces, eventually becomes consolidated into great cakes of sandstone for the same reason.

Cecil Carus-Wilson.

A Fresh Feature of the Large Larch Saw-fly Outbreak in the Lake District.

In the Lake District plantations, and elsewhere throughout the country, those interested in the welfare of the larch have viewed with no little apprehension, for some time past, the yearly ravages of the large larch saw-fly (*Nematus erichsonii*). As direct methods of control are out of the question over most of the affected areas, interest has been centred upon those natural agencies which in any way tend to limit the indefinite multiplication of this saw-fly, and it has been recognised that the atmospheric conditions, several of the common insectivorous birds, voles, certain insects, and parasitic fungus, are all capable of exercising a considerable if variable influence upon the numbers of the pest. To a combination of forces such as these must be attributed such respite as the trees have gained in certain of the infested areas, and in those cases where accurate observation of the facts was possible it was found that cessation of the saw-fly attack coincided with an overwhelming increase in the numbers of one of its insect enemies, an ichneumon, hitherto unknown to science, *Mesoleius tenthredinis*, Mor. This parasite, by eventually accounting for more than 70 per cent. of the larvæ within the cocoons, undoubtedly in these instances played a very large part in the reduction of the pest.

As *M. tenthredinis* was known to be present in most of the districts where the larch saw-fly was making itself felt, and as none of the other parasitic hymenoptera or diptera recovered from the cocoons from year to year showed signs of attaining to anything like its efficiency as a parasite, it was felt that the eventual control of the pest possibly depended largely upon the future activities of this one species. Hence the following observations made during the present season may be of interest in so far as they indicate the probability of other of the parasites attaining to a like importance.

Shoulthwaite plantation at Thirlmere, the first in that area to suffer from attack, endured during several summers the severest defoliation, until in 1910, owing to the good offices of *M. tenthredinis*, the ravages of the pest abruptly and almost entirely ceased. In 1911 it was impossible to obtain from there any further cocoons for the purposes of the investigation owing to the scarcity of the saw-fly. In 1912, however, this plantation was invaded by a vast swarm of adult saw-flies, which there was reason to believe came from a badly infested plantation some three miles away. Owing to a period of very unfavourable weather, and perhaps to other causes, the defoliation that ensued was not at all so extensive as it was feared it would be; however it was distinctly noticeable, and the consequences of this reinfection of the area were looked forward to with some anxiety. Would the trees, weakened by the old outbreak, have to submit to renewed defoliations, until such time as *M. tenthredinis*, re-emerged Cincinnatus-like from its obscurity, regained sufficient strength to overcome the progeny of the invaders? An examination of the parasites that have emerged this year from cocoons collected in this area revealed a quite unexpected state of affairs. Scarcely 2 per cent. of the cocoons proved to be parasitised by *M. tenthredinis*, but some 25 per cent. yielded specimens of an ichneumon which had hitherto played quite an insignificant part as a parasite of the large larch saw-fly (a species of Mesoleius, as yet undetermined). From approximately 24 per cent. emerged tachinids belonging to the species *Zenillia pexops*, B. and B. (Mr. C. J. Wainwright, who kindly identified it for me, informs me that he knows of but one other record of its having been taken in Britain.) It seems highly probable that both these parasites have followed in the wake of the invading saw-fly, particularly as observation of material from the locality from which it was suspected that the latter had flown has shown that the tachinid at all events is exceedingly abundant there.

It is impossible as yet to have direct proof of the efficacy of these two parasites in warding off defoliation in the areas in which they have so opportunely appeared, but it is very reasonable to suppose that, here and elsewhere, they will prove to be important enemies of the large larch saw-fly.

J. MANGAN.

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Mackerel and Calanus.

REFERRING to Prof. Herdman's interesting observations upon the above (NATURE, July 17), I may perhaps mention that the mackerel-drifters, when fishing upon the usual grounds around Scilly and in the Bristol Channel, are largely influenced in their selection of a suitable position by the finding of so-called "yellow water." This condition of the sea in the area under consideration arises from the presence of vast shoals of Calanoids—*e.g. Calanus finmarchicus*, *Pseudocalanus elongatus*, &c.—which impart a yellowish tint to the surface of the water. The sporadic distribution of such copepods, moreover, is often somewhat remarkable; the fishermen state that it is possible at times to observe the entire extent of a "splat" of "yellow water."

The presence of mackerel is generally to be expected in water of this character, but heavy catches are not invariably made in it.

G. E. BULLEN.

The Hertfordshire Museum, St. Albans.

THE FUTURE OF OIL FUEL.

THE position of liquid fuel has increased in importance far beyond any expectations its most enthusiastic advocates of but little more than a decade ago ever dreamed, due to the rapid advances made in its use in internal combustion engines. The success of engines of the Diesel type, which can employ crude oil or heavier residues after the lighter fractions of the crude oil have been removed for other applications, has furnished the completing link in the use of oil in such engines. With the petrol engine, slow-speed oil engines working on ordinary burning oil (kerosene), and the Diesel and semi-Diesel engines, high efficiency is now assured with any fraction of the natural oil.

The importance of liquid fuel and the certainty of its more extensive use in the Navy rendered it imperative that the whole question, especially that of supply, should receive consideration, and led to the appointment of the Committee now sitting. The advantages of oil fuel for steam raising were dealt with fully in these columns so far back as 1902 (vol. lxvi., p. 186), when oil fuel was in its early trial in the Navy.

The present general position and future policy of the Admiralty were outlined by Mr. Churchill in a reassuring speech before the House of Commons on Thursday last. Whilst the crude oil output for last year was nearly 50,000,000 tons, Naval requirements were met by fewer than 200,000 tons, and the Admiralty have assured themselves of obtaining all requirements in time of war, so long as British command of the sea is maintained.

This necessarily involves obtaining supplies by suitable contracts, and drawing specially upon supplies under British control, which is now possible from the Mexican fields. A far-reaching step in national policy is the further proposal to establish an oil refinery, so that crude oils may be dealt with as they come cheaply into the market. It is not only essential to have some measure of control of the supply at its source; it is equally essential to provide ample storage and transport facilities. The former has been arranged for on a large scale in this country and throughout the Empire, and by the end of 1914 the Admiralty will possess thirteen transport steamers, the five largest of which have a carrying capacity considerably greater than the quantity of oil fuel consumed throughout the fleet last year.

In connection with the subject of oil fuel, three Cantor lectures recently delivered by Prof. Vivian B. Lewes before the Royal Society of Arts[1] are of especial interest. The first lecture was

[1] Journal of the Royal Society of Arts, May 23, 30, and June 6, 1913.

devoted principally to theories on the formation of petroleum, and to the composition of natural crude oils. In the second lecture methods of combustion for steam raising, and, briefly, its use in internal combustion engines, were considered. Particular interest attaches to the possible high efficiency attainable when utilised for steam raising by Prof. Bone's surface combustion system. It is, however, in the third lecture that we find the all-important questions of supply discussed. Euthusiastic advocates of the advantages of oil fuel—advantages which are admitted—often forget that, with small exception, liquid fuel must always be an imported fuel in this country, and that the questions of supply and price must depend on a variety of factors, not the least important being that of transport. Prof. Lewes rightly emphasises the fact that trusts and rings are by no means wholly responsible for the recent high price of petrol; there is the big question of enormous increase in consumption with nothing like a corresponding increase in production Referring to this high price, Prof. Lewes says :—

The way to keep the price of petrol within reasonable bounds is not by letting the imagination run riot on the subject of trusts and rings, but to develop steadily all processes that will increase the supply, not only of petrol, but petrol substitutes, always bearing in mind that with the present consumption ever increasing, petrol itself cannot supply the market for even another ten years, and will probably be a rarity as a motor fuel before the end of the century.

This naturally leads to a reference to processes for "cracking" heavier oils to produce lighter fractions by the breaking down of the heavier hydrocarbons, and a description is given of one of these processes in which oil mixed with water is sprayed through heated iron retorts filled with iron turnings.

Referring to sources of supply other than petroleum oils, it is shown that shale distillation in this country can yield only an infinitesimal fraction of the petrol consumed. Benzene (benzol), obtained from coal-gas and coke-oven tars, being a native product of proved value as a motor fuel, is discussed. Prof. Lewes says that if the whole of the benzol from the 32 million tons of coal annually coked in coal-gas and coke-oven practice were recovered, a very considerable supply would be assured, but under existing conditions less than half the coke is obtained in recovery plant (it may be noted that the use of recovery ovens is extending rapidly), and most of the benzol goes abroad. Prof. Lewes appears to advocate removing the tax on petrol and the imposition of a tax on export benzol as a means of obtaining an important addition to our supplies of motor fuel.

Heavy fuel oils, suitable for steam raising and for internal combustion engines, constitute 50 per cent., or even more, of the crude oil. Prof. Lewes anticipates no such shortage in supplies of these oils in the future as has existed for some time past, for "the distillation of every available supply to yield petrol must result in enormous volumes being thrown on the market." The present shortage is ascribed to the better price of petrol giving it preference for shipment during a period when there is great lack of transport facilities. With the increase in the number of tank steamers (many yards are busy with such vessels) he anticipates that the enormous stocks held in many fields will become available.

IS CANCER INFECTIVE?

NOTWITHSTANDING that no analogy has been shown to exist between cancer and any known form of infective disease, the contrary is often asserted without proof, as a kind of creed, by well-meaning and enthusiastic students of the disease. A recent lecture illustrates the importance of the influence the latter view may come to have upon the public in general. Whether it is wise to put forward such views before a non-critical lay audience is open to doubt, even if they are told "there is no risk of direct infection, although it is better to avoid direct contact by kissing, by using in common table porcelain, clothing, or beds."

In a popular lecture[1] delivered at the Urania, in Berlin, Dr. V. Czerny, the famous surgeon, gives a clear account of the reasons why, after forty years' experience in surgical practice, he still holds that cancer is an infective disease. According to him it is communicable, not directly, but through an intermediate host. Once the infection is conveyed, the normal cells become changed, they destroy the organism not only by disturbing functions vital to life, but also because, like real parasites, the cancer-cells withdraw necessary foodstuffs, as well as secrete abnormal products of metabolism, viz. toxins which poison the organism. Czerny supports his view by arguments as to the varying frequency of the disease in different countries and in different districts of the same country, the alleged occurrence of epidemics of cancer, of the eyelid in cattle, of the thyroid in trout, and of cage epidemics in mice; but he neither points out the statistical and pathological fallacies that underlie the assertions of the authors whom he quotes, nor takes cognisance of the explanations more cautious authors have given of the apparent differences and "epidemics" upon which he depends. Every precaution necessary for the statistical study of cancer in man applies with even greater necessity to animals, since the data obtainable from an animal population can be controlled at will by the investigator. Unless these precautions are taken, weight may not be attached to reasoning from such imperfect data without important reservations.

Bugs, mucors, mites, worms, cockroaches, bilharzia, filaria, acid-fast bacilli, &c., are alleged as possible intermediate hosts of "the ubiquitous cancer parasite," which may be a protist, but more likely is an ultramicroscopic organism "which constantly secretes a chemical irritant. If one

[1] "Ueber die neuen Bestrebungen, das Los der Krebskranken zu verbessern." By Dr. Czerny. *Himmel und Erde*, Heft 7, April, 1913. Also published separately by B. G. Teubner, Leipzig and Berlin

conceives of these micro-organisms being adapted to the diseased cells and disseminated along with them by the lymph and blood-streams, a satisfactory explanation of the features of cancer in man is obtained. It is conceivable that there are a number of different micro-organisms which produce these irritating substances, and that there is not a single cause of cancer." The "ubiquitous parasite" finds entrance into the body by the openings made in the case of X-ray ulceration, chronic inflammation of all kinds, *e.g.* of the breast, the ulceration of the tongue following on the irritation of a jagged tooth, catarrh of the stomach due to alcohol or tobacco, ulcer of the stomach, ulcer or catarrh of the large intestine due to constipation; entrance for the parasite may even be made possible by congenital anomalies, &c., &c.

Although no evidence is adduced in support of these conceptions, any alternative to such an infective causation, involving as it does the further hypothesis of symbiosis of the parasite and the cancer-cell, is ruled out of court by Czerny. He says: "On account of the numerous errors made in the past, many pathologists have given up the search for a cancer parasite, and content themselves with some ingenious cellular theory, which suffices for instruction, but does not yield actual practical applications." Surely no practical application can yet be made of the infective hypothesis of the cause of cancer, although the taking of quite fallacious cancer censuses has been based upon it. The importance actual observation has given to chronic irritation has long since justified legislative measures for the protection of workers engaged in various occupations from enhanced liability to the disease.

Czerny reviews optimistically recent attempts to influence the growth of tumours by radium, X-rays, fulguration and chemical means, sera, &c., but his forty years' personal experience as a distinguished surgeon of international fame adds greater weight to his important announcement: "Unfortunately, the first beginnings of cancer are often so insidious that they do not attract the attention even of the patient himself, who first seeks medical advice when ulceration, a palpable tumour, pain—that faithful guardian of health—long-lasting digestive troubles, wasting, and bad looks warn him. Nevertheless, early diagnosis and removal of a condition *long remaining localised*, is the best means of restoring to complete health and avoiding the sad chain of consequences of the advancing disease. Therefore, with the assistance of anæsthesia and asepsis the surgeon has gradually sought out tumours in all organs of the body, even in the brain and spinal cord, and removed them. Naturally cancer comes under operation later, and therefore in less favourable circumstances the more inaccessible its situation. If success for tumours of the brain and spinal cord is rarer, still in the case of the skin 80–90 per cent. of cures can be depended upon. Complete cure in the case of the breast is obtained in 40 per cent., *i.e.* living and controlled five years after operation. For the stomach and intestine, 20–30 per cent. of success can be calculated on."

Since the first vague statements of the cure of transplanted cancer in mice by chemical means were made there has been a rising flood of similar announcements in scientific journals. According to the experience of the writer the greater number of these communications had better never have been published. The results claimed as cures have been for the most part nothing of the kind, but due to errors, sometimes arising in the properties of the tumour unknown to the "curer," at other times due to the observer being unaware of the behaviour of transplanted tumours in general and of the behaviour of a particular tumour obtained from some other laboratory, the observer being inexperienced both of how to obtain uniform growth and of the numerous fallacies he has failed to avoid. Shots in the dark, by those inexperienced in the growth both of experimental and natural tumours in animals, are, however, to be expected until more is known of the nature, chemistry, and metabolism of cancer, and certainty is attained as to whether or not it is an infective disease. But it would be a grave misfortune if the increasing flood of alleged cures of transplanted cancer in animals led to an augmentation of the number of persons who, disdaining or fearing surgical advice and treatment, prefer "treatment" by some other less efficacious or even useless method, or by some of the new chemical preparations already prematurely placed upon the market.

E. F. BASHFORD.

PLANKTOLOGY ON THE PACIFIC COAST.

THE school of marine planktologists at the University of California and the biological station of La Jolla (San Diego) is doing notable work on the Pacific under the expert guidance of Profs. Ritter and Kofoid. We now welcome a recent contribution on the classification and vertical distribution of the Chætognatha of the San Diego region, by Ellis L. Michael (University of California Publications in Zoology, vol. viii., no. 3). To begin with, the material is evidently very abundant. The locality in question shows seven out of the eighteen valid species of Sagitta, two of the three species of Eukrohnia, and one of the two species of Spadella. The author has done good work in redescribing and elucidating those species, and is to be congratulated on having failed to discover any new ones. The work has been confined to a comparatively small area, but it is evident that no pains have been spared to make it complete.

The author states: "We are convinced that direction and velocity of currents, temperature and salinity of water, wind, clouds, fog, rain, light and darkness all affect the distribution of plankton *even within a very small area*. The influence of all these conditions must be known to solve any problem concerning the quantitative distribution of plankton." All these influences have been very fully investigated.

The systematic part of the work contains a most useful revision of the known species of Chætognatha with a detailed key giving brief diagnoses of the genera and species, as well as a fuller statement of characters, with measurements of many specimens in the case of most species.

In the very full discussion of the problems of distribution, illustrated by many tables, we find that our author considers that his data contain numerous examples illustrating lack of uniformity in distribution. Some of these examples are as follows: In two hauls of the same net in the same region on the same day the number of *Sagitta bipunctata* varied from fifteen at 6.20 a.m. to one at 7.20 a.m. per unit volume of water. On another day, under similar conditions, the number varied from twenty-five to one, and on another day similarly from one to fifty-six, and on still another occasion from 135 to one. "Other instances might be cited, but enough have been given to show that the surface-distribution of *S. bipunctata* is not constant for any length of time, even in very small areas. The objection will be made that hydrographic and meteorological conditions change rapidly near the coast, but remain constant on the high seas. I doubt the validity of such an objection. In the first place, owing to variations in wind, rain, light, barometric pressure, heat, &c., it is very improbable that hydrographic and meteorological conditions even approach constancy on the high seas. In the second place, some of the above examples show that *S. bipunctata* varied in abundance even when these conditions, so far as known, remained constant during the period within which the contrasted hauls were made."

The author finds himself in agreement with similar observations that have been taken in recent years in the Irish Sea, and comes to the conclusion that "we are therefore compelled to acknowlege a very definite causal relation between rate of reproduction and variations in the quantity of plankton." He discusses the influence of other organisms on the abundance of plankton, and illustrates it by the effect of "red-water," due to the presence of enormous numbers of the dinoflagellate Gonyaulax, and recognises, consequently, that to estimate adequately the quantity of plankton in a given area of the sea we must consider far more than the physical and chemical conditions, and must not omit the biological influences involving the effects of growth, reproduction, food-relations, and other activities of the organisms concerned. As Kofoid (1903) has demonstrated, there are variations in the quantity of plankton which are nearly, if not entirely, independent of hydrographic and meteorological conditions.

Mr. Michael shows that *Sagitta bipunctata*, the commonest species that he deals with, is "epiplanktonic," and, moreover, migrates towards the surface at night and into deeper zones in the day. In the surface-nets this species attains its morning maximum within an hour after sunrise, and its evening maximum within an hour after sunset. He considers that it is probable that the species in its diurnal migrations is constantly moving towards that zone of water in which "twilight conditions" are to be found. The effects of salinity and temperature are also investigated in detail, and the conclusion that our author arrives at is that "probably light has more pronounced effect on vertical distribution than temperature or salinity, because its variations are more regular and periodic."

It is interesting to find that in a later paper in the same series from the University of California, viz., C. O. Esterly on the distribution of the Copepoda of the San Diego region, precisely the same general conclusions as to irregularity of distribution of the plankton are arrived at. In speaking of the absence of any uniformity, the author of this later paper says: "Instances of this could be given almost without number in regard to the distribution of the Copepoda of this region." The marine biologists of the Californian coast are clearly to be congratulated on the thoroughness with which their investigations are being carried out, and on the sound conclusions at which they are arriving. W. A. H.

PROF. FRANCIS GOTCH, F.R.S.

THE phenomena of life and their cessation at death present varied interests attracting to their investigation minds of very diverse type. Thus when the foremost ranks of physiology show a new-made gap, and a distinguished service of some one particular kind is at an end for ever, the loss to the science is not readily repaired. It is then too clear that the gifts which have vanished have differed from those that are left more than in degrees of excellence. Thus deeply at the present time physiology suffers by the death of the late Prof. Francis Gotch. His name is significant of a world-wide reputation. His personality was obviously individual, and in its peculiarities excellent.

Nothing that can be said in the near future can add to or detract from his established reputation. A master of the technique in one particular line, his measurements stand until that technique undergoes unforeseen developments and improvements. In that branch of the subject which he had made his own he had contributed to knowledge a long series of very precise data, placed with great skill at points of salient interest. Feeling no need for the incentives provided by explanatory hypotheses, testing no particular form of speculation, he has patiently and with great ingenuity assisted in a fundamentally essential survey of the physical evidences of life as studied in nerve, muscle, the retina, the special organs of electrical fishes, and in the central nervous system. Further than this, he was a distinguished authority upon the literature of this subject, and a writer of valued summaries and lucid historical articles.

Judged from his writings, he was what I have thus too briefly stated, namely, a dispassionate contributor, and a cold analyst, of evidence. Strange as may seem the contrast, to his students he was a magician, a marvellous weaver of deft words, a master of dramatic effects, who, with a sure hand, shaped before their eyes a brilliant texture of knowledge, ending always by laying down a finished carpet on which they might walk with reposeful security towards their own looms. His excellence in teaching the general groundwork of the subject was unique. Backed, as it was, by admirable practical classes, in which the niceties of technical skill required for the collection of evidence were instilled, and a whole field of evidence of a particular type displayed, it provided an educational basis of unsurpassable value. No one acquainted with his work will scent exaggeration in the statement that in this matter he was superb.

Outcome as this excellence was, in part, of unstinted effort and elaborate pains, and of a fully-developed desire to satisfy a genuine ambition for success in such teaching, it was also largely the result of native temperament and talent. A cheerful and courteous man, kindly to the core, generous to a fault. Humble with a knowledge of his own limitations, reverently serving undiscussed ideals, alight with enthusiasm. Of wide sympathy, singularly well-informed, of great culture, and most refined taste. Qualities such as these, and an evident sincerity in his devotion to his subject, necessarily won home to receptive and humane minds.

If at any time his manner caused irritation, then I take it this may be attributed to an excellent and uncommon quality, which was at times of great public service. He was essentially æsthetic, exquisitely sensitive to every light and shade in the inanimate, and in the animate character of his surroundings necessarily seeking harmonies, and as necessarily, therefore, arranging them. Neither inviting admiration nor in any way impelled towards dominance, nevertheless he was always quietly to the front to make certain that the scene was set, the players grouped, and a satisfying *ensemble* produced. Wherever such initiative was welcomed, as often in social matters where it is most rare, he was admirably successful. Arriving in Liverpool in 1891 as the first occupant of the newly endowed Holt Chair of Physiology, the complete sincerity of these qualities enabled him to give invaluable support to those able men who were then watchfully tending the growth of the university spirit within its boundaries. There, with his wife, he gained a great social success without underlying thought other than to give his best, and to obtain the best from others. His accomplished predecessor, citizens of great importance and benevolence, colleagues and students, he turned into grateful friends not of himself alone, but into mutual friends. That he was so signally capable of assisting in an obviously large and progressive movement, the development of university ideals of freedom in thought, in work, and in teaching, within a great and typical centre of commercial industry, must have had a reflected influence on his own character, and given him an added courage and skill in dealing with public affairs.

Leaving Liverpool in 1895 to occupy the Waynflete Chair of Physiology in Oxford, he returned to scenes already familiar. He was frankly pleased with this great and different opportunity; thinking it no small thing that he was entrusted with the banner carried so loftily by his distinguished master, whose influence had been largely responsible for the shaping of his career. If it is right to regard as ambition the desire to win complete recognition in a life-work not chosen from motives of dominance or gain, then it was his ambition which was now completely satisfied. In return for this satisfaction he endeavoured to perform the duties of this post of honour with anxious care and unflagging industry, shirking no responsibility. That he has proved equal to the task is evident from the continued success of the Oxford school of physiology, and from the value and numbers of its alumni who have passed out into, and maintain with credit, positions of great importance.

To his personal friends who have tramped through the mists of Cumberland fells, or wandered through the picture galleries and churches of foreign towns, with a companion so brimful of cheer and interest, or who have heard him tell the tale of his one participation in a cavalry charge in Zululand, or have listened to his renderings of Devonshire songs, his death has brought an intimate sense of loss.

To his wife and family, the centre of so much mutual love and understanding, we can do no more than offer sincere sympathy.

J. S. Macdonald.

NOTES.

Dr. R. von Lendenfeld, professor of zoology and rector of the German University of Prague, who died on July 3, aged fifty-six, had many friends and acquaintances in this country, where he resided for a time. He began his scientific career by travelling in Australia, where he studied chiefly marine sponges and cœlenterates. The results of his investigations were published, partly in English, as "A Monograph of the Australian Sponges," and other papers in the Proceedings of the Linnean Society of New South Wales, and partly in German, as a series of memoirs, entitled "Ueber Cölenteraten der Südsee." After his Australian trip he was for a time assistant in the zoological department at University College, London, and while in England produced, besides other works, his "Monograph of the Horny Sponges," published by the Royal Society, based chiefly upon material collected in Australia. Much of his earlier work was somewhat Haeckelian in the method of treatment, and later investigation has failed to confirm the accuracy of many of his statements, notably the existence of a nervous system in sponges alleged by him. Subsequently he published some works on sponges jointly with Prof. F. E. Schulze, of Berlin, and later, after he obtained the chair of zoology at Czernowitz, he published a monograph of the sponges of the Adriatic in a series of memoirs. When called to Prague he continued to publish, from time to time, systematic monographs upon the sponges collected by various expeditions. In addition to his zoological work he was a keen mountaineer, and contributed articles to various Alpine journals.

THE Dogs (Protection) Bill, which has for several weeks been before a Standing Committee of the House of Commons, but reached a deadlock on July 16, provides that it shall be unlawful to perform any experiment of a nature likely to cause pain or disease, with or without anæsthetics, upon dogs. The Bill would thus prevent, in this country, all experiments on dogs, not only all experiments under anæsthetics, but all inoculations. We may all of us be agreed that a dog has more claim on our regard than a rat or a guinea-pig; but we have to consider whether the Bill, in the long run, would lessen the sum of pain, disease, and death, in the world; and the answer surely is that it would not. Indeed, it would inflict far more than it would avert. For it would hinder in this country the proper and complete investigation, not only of human diseases, but also of canine diseases. Among human diseases, it would hinder the study of diabetes, and perhaps of kala-azar and of cancer. Looking back a few years, we can say that the Bill would have prevented, if it had been in existence, the discovery of the best vaccine against distemper in dogs, and the best treatment of malignant jaundice in dogs. Looking forward, we cannot foresee what the Bill would be preventing; but all experience goes to show that it would be preventing work useful either to man or to dogs. Experiments on dogs in this country are jealously restricted already by the Home Office; and the Bill is a move in the wrong direction. Some useful pamphlets on this subject can be had on application to the Research Defence Society.

MR. L. W. KING, assistant in the Department of Egyptian and Assyrian Antiquities in the British Museum, has been appointed to the post of assistant-keeper in that department.

CAPT. P. J. MARETT has been appointed to a Beit Memorial Research Fellowship to carry on further research as to the nature of the virus of sand-fly fever, a disease which is the cause of much sickness in the ships of the Mediterranean Squadron and among the troops stationed at Malta and in certain parts of India and elsewhere. The Army Council has approved of Capt. Marett, who has already published several papers on the subject, undertaking this research in addition to his military duties at Malta.

THE council of the Royal Society of Arts attended at Buckingham Palace on July 18, when his Royal Highness the Duke of Connaught, president of the society, presented to his Majesty the King, for nine years president and now patron of the society, the society's Albert medal for the present year, "in respectful recognition of his Majesty's untiring efforts to make himself personally acquainted with the social and economical conditions of the various parts of his Dominions, and to promote the progress of arts, manufactures, and commerce in the United Kingdom and throughout the British Empire."

THE Institution of Mechanical Engineers will meet at Cambridge on Tuesday, July 29, and Wednesday, July 30, in the Senate House of the University. The papers to be read and discussed are:—A new method of cooling gas-engines, Prof. Bertram Hopkinson; modern methods of measuring temperature, R. S. Whipple; modern pumping machinery for the drainage of the fens, R. W. Allen; the drainage of the fens, R. F. Grantham; the drainage of the River Ouse basin, E. G. Crocker; modern flour milling machinery, R. B. Creak; and a few notes on engineering research and its coordination, G. H. Roberts.

A SCHEME for the establishment of an Oriental Research Institute in India has been put forward tentatively by the Government of India, with a suggestion that an expression of the views of the provincial Governments be invited. Meanwhile the Royal Anthropological Institute has taken the opportunity of addressing the Secretary of State with a plea for the inclusion of anthropology in the course of studies at the institute. In his reply the Secretary of State observes that he is alive to the importance of anthropological research, and thanks the institute for its offer of cooperation, which is being conveyed to the authorities in India. But he points out that in the present state of the question it would be premature to discuss the exact scope of the proposed Research Institute.

WE understand that excavations in the base-beds of the Red and Coralline Crags of Suffolk have now been proceeding for some months under the direction of Mr. J. Reid Moir. Worked flints of various forms, consisting of the well-known rostro-carinate type, pointed implements for use in the hand, pounders, rubbers, round-ended and other scrapers, borers, hammer-stones, and flakes, affording evidence of a complete sub-Red Crag "industry," have been recovered. Extensive diggings at various sites have brought to light a small but very excellent series of humanly flaked flints, some of which have barnacles of the Red Crag Sea attached to their worked surfaces. With the exception of one small ridged flake, no humanly struck flints have as yet been found beneath the Coralline Crag.

THE KING has recently placed on loan for exhibition at the British Museum a large and valuable collection of gifts received by him from the Dalai Lama of Tibet. It includes a very sacred relic, a royal saddle, said to be 500 years old, and used by the first Dalai Lama who entered Lhasa; a set of Tibetan armour with a steel helmet, the armour being of a type spread over western Asia; a fine sword of the shape still used by the Khambas, the most warlike Tibetan tribe, which was probably made at Derge, and exhibits remarkable handwork. Tibetan Buddhism is represented by seven gilt images of the Seven Gems, which have been fully described by Dr. Waddell in his classical work, "The Buddhism of Tibet," and the Eight Glorious Emblems and Offerings. Among smaller objects is a model of a Chor-ten or shrine, charm-boxes, and a complete costume of a Tibetan lady, the gown of bright colours on a dark purple-brown ground, the boots of green and red cloth, embroidered in green and red.

The new Natural History Department of the Birmingham Museum and Art Gallery was formally opened on July 17 by Alderman W. H. Bowater (Deputy Lord Mayor), in the absence of the Lord Mayor through illness. The museum, which forms a part of the Council House extension, is situated on the upper floor of the building facing Congreve Street, and comprises four galleries, one of which is not yet opened, having been reserved for the Beale Memorial collection, which is to consist of nesting groups of British birds. The collections, which have been arranged by Mr. W. H. Edwards, contain representatives of most sections of natural history, and though birds, shells, and insects predominate at the present time, the committee hopes now the museum is started that generous donors may be forthcoming to supply some of the deficiencies. An interesting feature is a large case arranged on somewhat original pictorial lines, and illustrating a British marine topographical group. Sea-birds, some with their eggs, are mounted on a large rock, others are shown in flying positions, whilst the lower portion of the case represents a depth of 18 in. of sea-water, in which various fishes, an octopus, cuttle-fish, crabs, lobsters, &c., are shown as in a state of nature amongst seaweeds or resting on the sandy bottom. Special mention must be made of an extremely fine collection of British birds, including many very rare species, arranged in cases with their natural environment, and in various states of plumage. These have been lent by Mr. R. W. Chase, and occupy the whole of one of the galleries.

Aphides form the subject of the two chief articles in the July issue of *The Journal of Economic Biology*. In the first Prof. F. V. Theobald reviews the British representatives of the genus long known as Siphonophora, or Nectarophora, but for which the author employs the earlier title, Macrosiphum. Inclusive of twelve described as new, the British list comprises fifty-five species. In the second article Mr. T. R. Hewitt records the occurrence of a woolly aphis (*Schizoneura lanigera*) in the core of an apple, and suggests that such infestation may occasionally assist the dissemination of the species.

According to the July number of *The Entomologist's Monthly Magazine*, the greater part of the magnificent collection of butterflies and moths (including hundreds of type specimens) formed by the late Mr. Herbert Druce has been acquired by Mr. J. J. Joicey, of The Hill, Witley, Surrey. The representatives of the Lycænidæ and Hesperiidæ have, however, been retained by Mr. Hamilton Druce, and Mr. Druce's first collection of butterflies is now in the Natural History Museum. In communicating this information Mr. Joicey states that his portion of the collection is available for study to entomologists.

In *Spolia Zeylanica* for June Mr. E. E. Green describes, with coloured illustrations, a case of mimicry by spiders of the genus Cœnoptichus of the wingless forms of wasps of the family Mutilidæ, including those of the type genus. The general effect of the resemblance is most striking, the cephalo-thorax of the spiders having the red dorsal surface characteristic of many of the wasps, while in both groups the abdomen is conspicuously spotted with white or yellow. The spiders belong to one species, but mimic the whole group of wasps, and not any particular kind, protection being doubtless the object of the resemblance. Other Ceylon spiders belonging to the same family (Attidæ) mimic ants.

In *The Field* of July 12 Mr. Boulenger directs attention to the description by Mr. P. A. Ouwens in the *Bulletin du Jardin Botanique de Buitenzorg* for 1912 of a gigantic monitor lizard from the Isle of Comodo, between Flores and Sumbawa. The type specimen, described as *Varanus komodensis*, measured 7 ft. in length, but a second example is reported to have reached 13 ft., and there are stories of others with a length of from 19 ft. to 23 ft. The species appears to be related to the North Australian *V. giganteus*, which grows to 7 or 8 ft., but it has the muzzle less pointed and brown in colour, while the tail is proportionately shorter. That this giant of its tribe is distinct from all the other living representatives of its genus is certain; but Mr. Boulenger suggests that it may prove to be inseparable from *V. priscus*, of the Pleistocene of Queensland, the vertebræ of which appear to indicate a reptile at least as large as the biggest reported individuals of the Comodo monitor.

The latest publications of the Fisheries Branch of the Department of Agriculture and Technical Instruction for Ireland include a paper by Messrs. E. W. L. Holt and L. W. Byrne, on the fishes of the Irish Atlantic slope. Some species belonging to the families Stomiatidæ, Sternoptychidæ, and Salmonidæ are described and figured. The same part of the report also contains a paper by Mr. C. L. Boulenger on the luminous organs of the stomiatid fish, *Lamprotoxus flagellibarba*. Mr. R. Southern, in a further report, describes a collection of Gephyrean worms from the coasts of Ireland. Twenty-three species in all are recorded, and six of these are described as new to science. Five species are added to those previously known to exist in the British area. The author advances reasons for regarding *Golfingia macintoshii* of Lankester as synonymous with Blainville's *Phascolosoma vulgare*, and *Thalassema lankesteri* of Herdman as synonymous with Müller's *Thalassema gigas*.

Prof. O. Schmeil's "Naturwissenschaftliches Unterrichtswerk" series has enjoyed an extraordinary vogue in Germany, and when recently revising the botanical portion of the series the author found it necessary to omit certain branches of the subject in order to avoid undue extension of the general botanical volume, intending to write a special work on foreign economic plants. This has now appeared as a separate volume by L. Oberwalter, "Ausländische Kultur- und Nutzpflanzen" (Quelle and Meyer, Leipzig, price 2.40 marks), with an introduction by Prof. Schmeil. This book, uniform in plan with the other volumes in Schmeil's well-known series of manuals, is illustrated by fifty-nine figures, and forms an excellent introduction to economic botany.

One of the most important and difficult questions in connection with the maintenance of railways in India is the supply of suitable sleepers, and in a recent issue of *The Indian Forester* (vol. xxxix., No. 4) Mr. R. S. Pearson discusses the reasons why the forests of India, covering about 25 per cent. of the country, cannot apparently at present fully meet the demands of the railway engineers, who seem inclined to fall back on iron in default of a supply of suitable wood. On the railways running through the desert tracts, with climate ranging from severe frosts in winter to fierce dry heat in summer, and salt winds laden with sand, iron sleepers have proved unsatisfactory, since all kinds of iron become spongy under such conditions, and wooden sleepers last much longer. With the extension of railways in India the demand for sleepers is increasing, and for lack of suitable native wood large quantities of the Australian hardwoods have been imported during recent years; these answer fairly well in the damp climate of Bengal, but elsewhere have failed owing to inability to resist the attacks of white ants. The best sleeper wood in India and Burma is teak, but this is now used for other purposes, for which a much higher price can be paid, and Indian foresters are devoting considerable attention to the whole question of a suitable timber or timbers, and the equally important matter of suitable treatment to make the wood more resistant and durable.

In the June number of the Journal of the Board of Agriculture, Dr. Winifred E. Brenchley gives a survey of a season's work on weeds and their relations to the soils of Norfolk. Compared with results of similar work in Bedfordshire and the western counties, a greater number of species was observed in Norfolk, and this is attributed partly to greater diversity of the Norfolk soils (which are of drift origin) and partly to the larger area covered by the investigation. Some of the weeds are proving to have a real association with different types of soil, while others show decided local differences. The relative richness of sand and sandy loams in calcium carbonate is reflected in the flora, such "acid" plants as Rumex and spurrey never being found on these soils. Few species have a decided preference for heavy land, and practically none can be designated as absolutely symptomatic of clay, though a few are certainly characteristic; of these the chief are field foxtail, cut-leaved geranium, hogweed, and corn crowfoot. The occurrence of certain weeds with definite types of crop was also observed.

The Bulletin of the Philippine Weather Bureau for October, 1912 (recently received), contains particulars of four typhoons in that month, three of which crossed the archipelago. The most noteworthy was one which passed over the Visayas, or central group of islands, on October 15 and 16, and named the Leyte and Cebu typhoon. As the observations from Yap (Western Carolines) gave no indication of its existence it is supposed to have originated rather near the Philippines, probably about long. 132° E., lat. 10° N.; the Manila Observatory was, however, able to give timely warnings of its approach. The Rev. J. Coronas, S.J. (assistant director), states that the storm must be classified as one of prime importance, both on account of the lowness of the barometer in the neighbourhood of the vortex, 707 mm. (27·84 in.), and the consequent violence of the winds (seventy to eighty miles an hour), as well as on account of the torrential rains which caused inundations, more particularly in the south of Leyte and north of Cebu. All towns within a radius of twenty miles from the storm centre describe their losses as incalculable, and several interesting photographs are given showing the destructive effects of the typhoon. The great loss of life in Cebu is partially due to the facts (1) that little attention was paid to the warnings, and (2) that the vortex passed near midnight, whereas in Leyte it passed during the daytime.

The Electrician for July 4 contains a description of a method devised by Mr. G. B. Burnside for sealing metallic conductors, *e.g.* copper into glass directly. The essential feature of the method consists in the repeated immersion of the glass and metal, immediately the fusion in the usual way has been effected, and the glass has cooled to a red heat, into a slightly heated bath of oil or fat for a second or two, the extent of the immersion being increased each time. For currents up to 15 amperes solid conductors may be used, but above that it is advisable to fuse in tubular conductors. The author has experienced no trouble with these joints, and has found that a copper tube capable of carrying 100 amperes fused into glass in this way may be heated to 100° C. without the joint showing any signs of deterioration. The method solves a difficult problem, and obviously has a wide range of applications.

Two recent Memoirs of the College of Science and Engineering, Kyoto Imperial Observatory (vol. iv., Nos. 1, 2), show that the Japanese are prepared to follow up their previous excellent work in connection with geodynamics and latitude variation by some other thorough-going researches. The volume for which Prof. Toshi Shida is mainly responsible, contains an interesting account of preliminary horizontal pendulum experiments conducted at the Kamigamo Geophysical Observatory. The results of these experiments so far confirm the larger value for the effective rigidity of the earth found by Herglotz from the Chandler period of free nutation. This is about twice the value derived from the results of tidal observations and deflections of the plumb-line. Hecker's Potsdam observations have been analysed by Messrs. Shida and Matsuyama for the lunar diurnal term. The results confirm the idea that Hecker's observations, at any rate for one pendulum, were either seriously affected by some local disturbance (*e.g.* pumping in the well) or else represent some abnormal behaviour locally of the earth's crust. Another interesting communication from Prof. Shida is his discussion of volcanic tremors. His attempt to deduce the Chandler period from the time distribution of volcanic eruptions is interesting if not convincing. It gives the value 431·45 days. The z-term in the variation of latitude—or the Kimura term as it is known in this country—comes in naturally for discussion in a Japanese memoir. Prof. Shinzo Shinjo enters into a careful discussion of possible physical explanations, and ascribes it to anomalies in zenithal refraction. In this view he is in agreement with Dr. Frank E. Ross. Without being able to give any accurate numerical result, he suggests that in periodic changes in the refraction may be found in part the explanation of the discrepancy between the values of the aberration constant derived from the solar parallax and that given by Talcott's method. Further work can alone elucidate the point.

Engineering for July 18 gives an account of investigations made by the United States Bureau of Mines on the ignition of mine-gas by glow-lamps. That all types of glow-lamps are not equally liable to cause ignition of explosive gas was known from previous experiments, conducted chiefly in Belgium, France, and Germany. The American investigators come to the following chief conclusions:—The naked carbon filaments of standard types of lamps, burning at rated voltages, will invariably ignite explosive gaseous mixtures. If the gas can reach those filaments without breaking them, or without producing partial combustion within the bulbs, the gas is sure to be ignited. Several, but not all, sizes of standard lamps (carbon and metallic filaments) and of miniature lamps (small lamps for miners) will ignite the gas when smashed while burning at rated voltages; those lamps which do not cause ignition usually, may do so if the broken pieces of the filament produce a short circuit when the lamps are smashed. Reviewing the results, all the lamps tested must be considered unsafe, though some specimens of a class might not cause ignition. Alternating or direct current, and coupling in series or parallel, made little difference.

MESSRS. J. and A. CHURCHILL have nearly ready for publication the seventh edition of "The Microtomist's Vade-Mecum," by A. B. Lee; the sixth edition of the late Prof. J. Campbell Brown's "Practical Chemistry," edited by Dr. Bengough; and the third edition of "A Text-book of Physics," edited by A. Wilmer Duff.

THE publication of a new series of books, entitled "The Cambridge Technical Series," and edited by Mr. P. Abbott, is being undertaken by the Cambridge University Press. The series will be comprehensive and will include the whole sphere of technical work in the widest sense. Among the subjects arranged for are:—Automobile engineering, electro-technical measurements, chemistry and technology of oils and fats, mining geology, and domestic science.

A COPY of their new list of wireless apparatus and accessories has been sent to us by Messrs. F. Darton and Co., 142 St. John Street, Clerkenwell, London, E.C. This firm has a long-distance installation at work at its factory, and makes a practice of explaining the most efficient methods of using the apparatus supplied to customers. The list is well illustrated, and full particulars of many forms of transmitting and receiving apparatus are supplied.

OUR ASTRONOMICAL COLUMN.

PERIODIC SPECTRUM OF α CANUM VENATICORUM.—Prof. A. Belopolsky publishes in *Astronomische Nachrichten*, No. 4664, the epochs of maximum intensity of the dark line $\lambda = 412{\cdot}993$ $\mu\mu$ in the spectrum of α Canum Venaticorum. Fifty hours is stated to be the length of time of the visibility of this line, and the periodicity very near 5·50 days. Other lines become faint at these epochs.

1913 July	24·96 G.M.T.	Aug.	15·96 G.M.T.
,,	30·46 ,,	,,	21·46 ,,
Aug.	4·96 ,,	,,	26·96 ,,
,,	10·46 ,,	Sept.	1·46 ,,
		,,	6·96 ,,

STARS HAVING PECULIAR SPECTRA.—The observations carried out by Miss Cannon for the Revised Draper Catalogue have added already ten stars to those known to have bright lines in their spectra, and twenty-four new composite spectra. Details of these are given in Harvard Circular 178. The bright-line stars have spectra belonging to classes ranging between B3 and Oe. The latter shows the bands $\lambda\lambda$4633 and 4688 bright, whilst Hβ is seen bright in the rest, one also showing Hγ as a bright line. Of the twenty-four stars showing composite spectra only four are included in Burnham's General Catalogue of Double Stars.

In the same circular it is remarked that a photograph of the spectrum of Nova Geminorum No. 2 secured on April 5, 1913, shows only slight changes since November 9, 1912, when the brightest band was at λ4363. Between $\lambda\lambda$4686–5007 the spectrum resembles that of the prevailing type of gaseous nebulæ, but differences occur in other portions of the spectrum.

THE ORIGIN OF THE PLANETS.—In a memoir communicated to the American Academy of Arts and Sciences (vol. xiv., No. 1) Prof. P. Lowell arrives at some interesting conclusions regarding the genesis of the solar system. Inquiring into the causes of a striking commensurability exhibited between the mean motions of adjacent planets some of the deductions he makes are:—(1) The planets grew out of scattered material; (2) each brought the next one into being by the perturbation it induced; (3) Jupiter was the starting point, and is the only one of the planets that could have had a nucleus at the start.

Prof. Lowell enunciates the following law:—"Each planet has formed the next in the series at one of the adjacent commensurable-period points, corresponding to $\frac{1}{2}$, $\frac{2}{5}$, $\frac{1}{3}$, and in one instance $\frac{3}{5}$ of its mean motion, each then displacing the other slightly sunward, thus making of the solar system an articulated whole, an inorganic organism, which not only evolved but evolved in a definite order, the steps of which celestial mechanics enables us to retrace."

On the basis of this law he makes some predictions regarding "the nearest trans-Neptunian planet"; thus it should have a major axis of 47·5 astronomical units, and a mass comparable with Neptune, though probably less.

THE HULL MEETING OF THE MUSEUMS ASSOCIATION.

THE annual conference of the Museums Association was held at Hull last week, under the presidency of Mr. E. Howarth. There was a large attendance, including representatives from abroad, as well as from numerous places in the British Isles.

As his presidential address, Mr. Howarth gave a helpful and suggestive discourse on the scope, function, and development of museums, using the word in its most comprehensive sense. He pointed out that though the universe could not be represented in a museum, yet even the provincial institution was doing work of a national character. It would be foolish to attempt to reproduce the British Museum in every town, but the principles dominating it were applicable to the smallest village museum. Museums should hold a recognised position in the scheme of national education from its base to its summit, and each museum, whether its teaching be general or specific, should do more than merely provide object-lessons. It should focus attention upon the progress of human knowledge and achievement. This cannot be done by punishing the visitor with endless series of specimens of interest only to the specialist. It must be accomplished by selecting a strictly limited number of objects, and so displaying them as to endow them with an intensely human interest. The gathering together of objects of local significance should be the primary duty of the curator, and their effective display his greatest achievement.

In a paper entitled "Methods of Collecting," Mr. T. Sheppard gave a brief account of the growth of the Hull museums. As evidence of continued development it may be mentioned that at the association dinner it was announced that Colonel G. H. Clarke had determined to purchase and present to Hull the Mortimer collection of prehistoric antiquities, geological specimens, and other relics, at present housed in the museum at Driffield. The announcement was received with the greatest enthusiasm, for the collection is renowned as one of the best series of Yorkshire prehistoric antiquities in existence, and its value is enhanced by the careful and scrupulous records kept by Mr. Mortimer.

The most novel paper of the conference was probably that given by Mr. J. A. Charlton Deas, of Sunderland, "How to Show our Museums and Art Galleries to the Blind." In essence this was a report of experiments made by Mr. Deas at the Sunderland Museum and Art Gallery, where demonstrations have lately been given to parties of blind people, both adults and children. Blind visitors in the museum were taken in hand by guides. They handled certain specimens, and each feature was explained at the moment of touch. Attached to each specimen was a carefully drawn-out descriptive label, which was read by the guide, and great care was taken in leading the hands or fingers of the blind to the important features. Mr. Deas emphasised the need for conscientious guiding of the blind person's hands, and said that where possible there should be a guide for each blind visitor. The blind children of the council school were also taken in this way through the museum and art gallery. Some remarkable models were made, after the examination of the specimens, by children between eight and fifteen years of age, none of whom had any special knowledge of modelling. In fact, in some cases they were a first attempt. The models, though rough, showed in many cases remarkable spirit.

Prof. Roberts Beaumont, of Leeds University, read a paper upon the organisation of a textile museum, in which he said that the subject, though a large one, had not received that full attention which those connected with the textile arts considered it should have. He insisted upon the importance of illustrative models being technically correct, and effective for the demonstration of the purpose and function for which the machines were originally invented. Nor is it enough to furnish the student with specimens illustrating the history of textile ornament. Such analyses should accompany the specimens as would make them increasingly suggestive to those who viewed them and increasingly inspiring. A textile museum should set forth the history of manufacture and the process and sequence of invention, typifying the nature, scope, and function of each department of the industry, exemplifying each phase of woven art, stimulating research, and proving a veritable storehouse of classified knowledge.

Mr. J. W. Baggaley described a simple and efficient gelatine and glycerine cement by means of which he had been able to mount zoological specimens in spirit.

The association was honoured by the presence of Prof. F. Rathgen, chemist to the Royal Museum at Berlin, whose experiments and writings on the treatment and preservation of antiquities are so well-known to all curators. He gave a paper on the decay and preservation of antiquities, which aimed at giving an outline of the various causes underlying the disintegration of antiquities after excavation, due to the changes which have taken place during varying periods and conditions of interment.

Mr. Cecil W. C. Hallett and Mr. J. H. Leonard, official guides at the British Museum, Bloomsbury, and the British Museum (Natural History), South Kensington, gave accounts of their personal experience in conducting parties of visitors around these great national institutions. Arising out of this experience they were able to give many valuable hints as to the precautions to be taken to ensure successful and enjoyable demonstrations. Some of the difficulties which present themselves—such as noise, interruption from visitors not belonging to the party, &c.—were admittedly difficult to remedy, but, as public appreciation and the powerful advocacy of such friends of museum work as Lord Sudeley seem destined to bring this mode of spreading knowledge of our potentialities into vogue, it is essential that they should be overcome.

Mr. Reginald A. Smith, of the British Museum, gave a paper on curators and the Stone age. He directed attention to the fact that Britain was rapidly showing itself to be a much richer field for discovery in this direction than we have hitherto believed, and that the subject has now attained such public prominence as to call for close attention on the part of the curator. Stone-age archæology may now be described as being in the melting-pot, and it is our duty to see that we assimilate the new and far-reaching ideas which emanate therefrom.

The paper part of the meeting concluded with some interesting remarks by Dr. F. A. Bather, F.R.S., on fittings and preparations noted during a recent visit to the museum of the Institut Océnographique at Monaco, and a message from the Rev. Prof. Henry Browne emphasising the need for assistance from museums in the furtherance of classical studies.

The business meeting had several matters of special interest to consider, foremost amongst which was the question of grants by the Board of Education in aid of the purchase of scientific specimens for provincial museums. These grants have been in abeyance for several years, but the advisory council for the science museum has now taken up the matter, and a sub-committee recently received a deputation from the association in a most understanding and sympathetic spirit. The outcome is that the Museums Association has been asked to submit its views as to the direction in which grants would be helpful and appropriate, and as to the conditions which should accompany them.

The following resolutions were passed:—

"That this association desires to direct the attention of the Board of Education to the great value to provincial museums of the collections sent out by the Victoria and Albert Museum, and trusts that, now that the circulation department has been made a self-contained section of the museum, with no power to circulate any of the specimens in the general museum, the collections available for circulation will be augmented to meet the requirements of the provincial museums, which steadily increase in number, and are undoubtedly attaining a higher level of artistic excellence."

"The Museums Association, at its annual conference in Hull, 1913, declares itself in cordial sympathy with the proposal to make provision in the grounds of the Crystal Palace for a British Folk-Museum on the open-air plan, and expresses the hope that the Right Hon. the Lord Mayor of London will use every endeavour to carry the proposal into effect."

The conference concluded its business by electing Mr. Charles Madeley, director of the Warrington Museum, to be president for the 1914 meeting, which is to be held at Swansea.

THE ELECTRIC FURNACE SPECTRUM OF IRON.

IN NATURE for April 24 (p. 200) we gave a brief account of the researches carried on by Mr. A. S. King, of the Mount Wilson Solar Observatory, upon the variations of the spectrum of titanium in the electric furnace. Mr. King has now concluded an investigation of the variation with temperature of the electric furnace spectrum of iron, an account of which is published in No. 66 of the Contributions from the Mount Wilson Solar Observatory.

This communication, like others of his on a similar subject, is of great interest, because it shows that the spectrum of a substance is not the same for any temperature. By knowing what spectrum is given at a known temperature it is possible to determine the temperature of stars or portions of the sun, and so utilise these laboratory researches for stellar and solar spectroscopy.

While a great amount of work has already been done in the case of iron, one of the earliest being the differentiation of temperatures by the short- and long-line method of Lockyer, Mr. King has all the advantages of the latest form of furnace and method of determining accurately the varying temperatures for the lower stages of temperature.

One of the great problems in these investigations is to determine whether the changes described are due to temperature or to electrical or chemical conditions which are present in different degrees in the sources of heat.

In a brief summary like this it is not possible to state all the conclusions which the research has led Mr. King to deduce, but the more important may be briefly summarised. In the first place, he has been able to divide into six classes the relative intensities of the iron lines in the visible spectrum for three furnace temperatures and the arc, basing them on the temperature at which a line appears in the furnace, and its rate of growth as the temperature increases. In passing from the furnace to the arc the changes in relative intensity may generally be accounted for by a difference in conditions equivalent to a large temperature difference. The ultra-violet was found a rich region for lines, and it was noted that increase of temperature corresponded to an extension of the line spectrum towards shorter wavelength. The increase in intensity of lines from the outer vapours into the core of an iron arc was found usually to resemble the rate of growth shown by the same lines with rising furnace temperature, and this the author suggests renders it unlikely that chemical reactions in the outer vapours affect the relative intensity of arc lines in any large degree.

So far as the visible region is concerned the enhanced iron lines are above the furnace stage, no lines being observed in the furnace spectrum. The furnace spectra at low and medium temperatures were found, except perhaps in the ultra-violet, to be very similar to those of the several flames.

The author concludes that while there is no definite proof that temperature radiation in a strict sense takes place, the position of temperature as the exciting and regulating agent in furnace phenomena seems to be clear.

ANTARCTIC LICHENS.[1]

LICHENS form a quite exceptional group of plants with many peculiar features, the chief among which is the fact that they are compound organisms, a lichen consisting of a fungus individual and numerous alga individuals—the fungus with its branched and interlacing threads has grown around the alga cells and enclosed them in a nest. The result is that the lichen can grow in places which would be quite unsuitable for the independent existence of either the fungus or the alga of which it is composed. Algæ grow in water or in moist places, while most fungi are extremely sensitive to cold and drought, but lichens can thrive in the bleakest positions and in the most severe climates, as on bare mountain rocks and in the farthest circumpolar regions reached by explorers—provided that the land surface is not covered by perpetual snow. In alpine and arctic regions, lichens do important pioneer work, helping to break up the hardest rock surfaces and prepare soil on which other plants can grow; while on steeply inclined and bare rock, lichens, along with minute algæ, are in general the first colonists.

These pioneer lichens are of the flat crustaceous and foliose types, the former attached closely to the substratum by their entire underside, the latter clinging more loosely, and being therefore detachable without chipping off bits of the rock itself in order to obtain specimens. On less steeply inclined parts, where the vegetation is older, the shrubby or fruticulose lichens are added; these are fixed at the base only, and show much greater variety of form than is found among the encrusting and leafy types.

In his report on the lichens of the Swedish Antarctic expedition, 1901–3, under Dr. O. Nordenskjöld, which has recently been published, Dr. O. V. Darbishire adds to his descriptions of the new species an interesting summary and discussion of the distribution of lichens in the arctic and antarctic regions generally. Unfortunately the good ship *Antarctic* was crushed by ice in January, 1903, and a large portion of the plants collected during her cruise along the coast of Graham Land had to be abandoned when she sank a month later; but though doubtless a considerable amount of material was lost in this disaster, a rich harvest was brought back by the botanical members of the Swedish expedition. This includes no fewer than 145 species of lichens, of which thirty-three are new.

An analysis of the results of antarctic expeditions up to and including Charcot's (1905) shows that at present 106 lichen species are known from the land which lies strictly within the antarctic limits, and that of these thirty-two also occur in subantarctic America, twenty-five in New Zealand, and sixteen in South Georgia, showing a very close affinity between the antarctic lichen flora, on one hand, and the American and New Zealand floras, on the other—the difference to the disadvantage of the latter being accounted for by the greater nearness of the subantarctic American region to the extreme limit of the southern drifting pack-ice. The lichens of subantarctic America and New Zealand are also very nearly allied, for out of 133 lichens in the former flora, 113 are found in New

[1] "The Lichens of the Swedish Antarctic Expdition." By Otto Vernon Darbishire. Wissensch. Ergebn. der schwedischen Südpolar-Expedition. 1901–1903. Band iv., Lief. 11. Pp. 1—73+3 plates. (London Dulau and Co., Ltd., 1912.) Price 8s. (Subscription price 6s.)

Zealand, 32 in the Antarctic, and 31 in South Georgia, the latter being evidently, from the phytogeographic point of view, a half-way house on the road from subantarctic America to the true antarctic area. Moreover, practically half of the antarctic species are common also to the arctic regions.

Of the 106 antarctic lichens, sixty-nine are crustaceous, eighteen foliaceous, and nineteen fruticulose species; of these, the numbers found in subantarctic America are respectively sixteen, five, and eleven. Of the sixty-seven species found only in the true antarctic area, forty-nine are crustaceous, ten foliaceous, eight fruticulose. The subantarctic American lichen flora includes 366 species, while 740 species have been enumerated for New Zealand; of the species common to the two regions 50 per cent. are fruticulose, 30 per cent. foliaceous, and only 20 per cent. crustaceous. The affinity of the subantarctic American and New Zealand lichen floras lies mainly in the fruticulose lichens, which are the oldest and probably the least variable forms. The encrusting species are more variable and have adapted themselves more readily to local conditions, thus giving rise to new species. An interesting point arises from a comparison with northern lichen floras. The arctic area had nearly 500 lichens, of which 72 per cent. are found in Tyrol. Thus the relation of arctic to alpine lichens is much greater than that of subantarctic American to New Zealand species, indicating that the latter are further from the point of common origin.

Dr. Darbishire raises the interesting question of the resistance of cold by lichens, and suggests some simple experiments which might be made on lichens in the very coldest regions. For instance, it would be of the greatest importance to determine the amount of water contained in the lichen thallus at various times and seasons. In what condition are lichens during the long winter? At what temperature does assimilation commence? It is of little use to try experiments on plants in warmer climates, if we wish to ascertain how these small plants can live under the adverse conditions prevailing in the arctic and antarctic regions.

Lichens are found everywhere on the outer limits of vegetation, and their chief ecological distribution factor is their power to become quite dry and yet remain alive. No doubt it is this property which enables them to spread slowly but surely into the bleakest and most inhospitable regions. They are making their way towards the north and south poles, and so far they have been beaten in their race only by the perpetual covering of snow. There is little doubt that if bare rocks are found in the neighbourhood of the poles themselves, lichens will be found growing there.

Dr. Darbishire's memoir is illustrated by three double plates of beautifully reproduced photographs, depicting the new species brought back by the expedition.

F. C.

APPLICATIONS OF POLARISED LIGHT.[1]

ON November 30, 1812, just above 100 years ago, the French physicist Biot communicated to the Institute of France a memoir "on a new kind of oscillation which the molecules of light experience in traversing certain crystals." In this paper, which extends over 371 pages of the printed memoirs, the phenomenon of "rotatory polarisation" was described for the first time. This phenomenon depends on the property which certain substances possess of taking a beam of polarised light and imparting a twist to the plane of polarisation: the beam of light enters with all the vibrations compressed, say, into a vertical plane; it emerges apparently unchanged, but careful examination shows that the component vibrations are no longer vertical, but inclined either to the right or to the left. The importance of this discovery to physicists and to crystallographers was immediately obvious. In our own generation its fertility has been realised also by chemists, who have found in the polarimeter an instrument which promises to render to the science services not less notable than those which have been accomplished with the help of the spectroscope.

[1] Discourse delivered at the Royal Institution on Friday, April 18, by Dr. T. M. Lowry.

A.—*Sources of Polarised Light.*

If one were to ask what progress had been made in the facilities for applying polarised light to the study of chemical and physical problems, the answer would be twofold. On one hand it must be acknowledged that the "Iceland spar," by means of which Huyghens in 1678 first detected the polarisation of light, is still the best substance for producing this effect. But the increasing demand for the spar has not been accompanied by any corresponding increase in the supply, and large clear pieces of the mineral are becoming increasingly difficult to procure. It may indeed be doubted whether large polarising prisms such as those which have been handed down as heirlooms at the Royal Institution could now be purchased at any price, in view of the "spar-famine" which has prevailed for some years.

Considerable advance has, however, been made in the direction of improved methods of illumination. The solar light, which figured so largely in the experiments of the earlier workers, is too precarious to satisfy the ardent worker of to-day, and in any case could render no direct assistance in illustrating a Friday evening discourse. When Faraday, on Friday, January 23, 1846, delivered his discourse on the magnetisation of light to an audience of 1003 persons, the source of light in the experiments which he described was an Argand gas-burner. Prof. Silvanus Thompson in 1889 was able to use the electric arc, which was then just beginning to come to the front as a commercial illuminant. With this unrivalled source of light he was able to show for the first time in a public lecture a large number of the properties of polarised light which had been reserved hitherto for individual observation in the laboratory. The remarkable effects which are seen when light of one single colour or wave-length is substituted for white light were shown by Spottiswoode in 1878, with the help of a powerful sodium-lamp which had been devised by Sir James Dewar. His lecture was aptly described as "A Nocturne in Black and Yellow."

During several years I have taken a special interest in seeking to discover other sources of monochromatic light for use, in experiments on polarisation, and have been particularly concerned to proclaim the merits of the mercury arc as an illuminant for everyday use in optical investigations.

The Mercury Arc.

The spectrum of the light produced by passing an electric discharge through mercury vapour was described by Wheatstone in 1835 in a report to the British Association on the prismatic decomposition of electric light; but it was not until twenty-five years later that a real mercury-lamp was invented by Prof. Way. This consisted of an intermittent jet of mercury which was directed into a cup half an inch below. The current from a battery of Bunsen cells was passed through the jet and developed an intense light. The spectrum of the light was examined by Dr. J. H. Gladstone, and described in a paper on the electric light of mercury, published in the *Philosophical Magazine* of 1860 (vol. xx., pp. 249–53).

The first use of the mercury arc as a source of light in polarimetry appears to have been made just ten years ago by two German workers, Disch and Schönrock, working independently (Disch, *Ann. Phys.*, 1903 (IV.), vol. xii., 1155; Schönrock, *Zeit. Vereins Deutsch. Zuck. Ind.*, Tech. Part, 1903, vol liii., 652). Through the personal kindness of Mr. Bastian, I was enabled about three years later to make use of the same source of light in what is still, perhaps, its most convenient form. The glass Bastian lamp was designed to burn with the coils of the arc in a horizontal plane, and was arranged to light automatically in this position. It was with great delight, therefore, that I discovered that, in spite of all warnings to the contrary, the lamp would continue to burn for any length of time with the coils raised into a vertical plane; in this position one of the straight portions of the arc could be focussed by a condenser directly on to the slit of a spectroscope, and so used to illuminate the field of a polarimeter. The lamp consumed very little current, and could be connected directly to the ordinary lighting circuits without any risk of "blowing" the fuses; it was cheap to purchase, and as the resistances formed part of the holder of the lamp there was no need for any auxiliary apparatus whatever. In view of its special suitability for polarimetric work, it is to me personally a matter of some regret that this pioneer lamp has been displaced completely by the more powerful arcs, encased in refractory silica glass, which now adorn the exteriors of so many places of amusement.

When using the mercury arc as a source of violet light, account must be taken of the greatly reduced sensitiveness of the eye to light of such short wavelength. It is here that the silica mercury lamp has proved of such great utility. I am indebted both to Mr. Lacell, of the Silica Syndicate, and to the Brush Electrical Engineering Company for allowing me, for experimental purposes, to distort their well-considered designs for commercial mercury arc lamps. Here, for instance, is a horizontal lamp which has been altered so that the arc can be seen at its greatest intensity in an end-on position. At first the light was liable to be obscured by globules of condensed mercury. But by recessing the window it was kept sufficiently hot to prevent condensation, and this difficulty was effectively overcome. Even then, however, the arc was not so convenient as one arranged in a vertical plane, like the upturned Bastian lamp. It was at this stage that I persuaded the Brush Company to modify for me their "Quartzlite" lamp by twisting one of the terminal **U**-tubes into such a position that it did not empty itself when the lamp was raised into a vertical plane. The "end-on" lamp and the vertical "Quartzlite" lamp have been described in the Transactions of the Faraday Society (1912, vol. vii., pp. 267–70), and were exhibited at the Optical Convention of June, 1912. The lamp shown in Fig. 1 has not been described previously. It combines the merits of both of the preceding patterns, and can be used either horizontally or vertically, and either in a side-on or in an end-on position.

The "Pinch Effect."

One feature of the silica mercury-lamps is sufficiently remarkable to deserve attention. When the arc is first struck by tilting the lamp it fills the whole of the bore of the half-inch tube which encloses it; but, in accordance with Faraday's observation that currents travelling in the same direction attract one another, the parallel threads of current are drawn together until finally, as you see, the arc is "pinched" together into a thread occupying only about one-third of the diameter of the tube. This pinching together of the arc contributes substantially to its efficiency as an illuminant in polarimetric and spectroscopic work; but it is not a suitable form for projection, which demands, as a condition for successful work, a powerful point-source of light.

If the current in the mercury arc is increased, the pinching effect may extend to the point of breaking the threads of current completely and so extinguish the arc.

It may be of interest to refer here to the well-known fact that the "pinch effect," which I have exhibited on a small scale in a mercury-lamp, is of great importance in the electrical melting of steel on a large commercial scale. In that case a current of great magnitude, flowing through a mass of molten steel enclosed in a circular channel, sometimes causes the metal to pinch together to such an extent that the circuit is actually broken. The "pinching" apart and running together of the mass of molten metal produce a somewhat thrilling display.

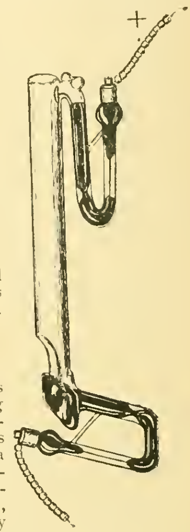


FIG. 1.—Mercury lamp for use in a horizontal or vertical, side-on or end-on position.

The Mercury Spectrum.

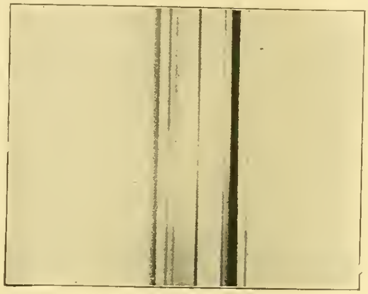
The mercury arc differs from the carbon arc in giving an extremely simple line-spectrum, the chief features of which are a yellow, a green, and a violet component. The yellow component contains two lines, separated by about twenty units of wave-length as compared with six units for the yellow sodium doublet; it shows up well in the spectrum, but on account of its duplex character it is not suitable for use in exact measurements.

By means of powerful high-resolution apparatus, such as the echelon spectroscope, the green line of the mercury spectrum has also been shown to be complex (Fig. 2); but in this case the components are so close together that they do not in any way reduce the value of the line as a source of monochromatic light. The extreme brilliancy of this green line, its high spectroscopic purity, and the ease with which it can be produced, have given to it an unrivalled position amongst the various sources of monochromatic light which are now available for polarimetric work. I can say with confidence that no one who has worked with the mercury-lamp will ever wish to return to the sodium flame, which it is rapidly displacing both in scientific and in technical laboratories.

Dr. Gladstone directed special attention to the strength of the violet lines in the spectrum, of one of which he said that "this ray is situated far beyond what is ordinarily considered the limit of the luminous spectrum." This deep-violet component contains two lines which are clearly visible in the spectroscope; but they lie so near to the limit of visibility that their presence can be shown most clearly with the help of a fluorescent screen. The bright violet line is, from the scientific point of view, one of the most valuable features of the mercury spectrum. The main line is accompanied by two satellites of greater refrangibility; But these are so close to the principal line, and are of so much smaller intensity, that they do not diminish appreciably the unique value of this line, which still remains the most powerful source of monochromatic light for work at the violet end of the spectrum. Actual measurements in which the violet line has been used, both with and without the satellites, have shown that the errors introduced by the presence of the latter do not exceed one part in 10,000 on the readings of a polarimeter. This error would, therefore, be quite inappreciable in the case of all readings of less than 100°.

The visible spectrum does not by any means exhaust the usefulness of the mercury arc. The powerful series of ultra-violet lines, which are freely transmitted by the glass of the silica lamps (Fig. 3), are of value for a number of scientific purposes, and have found an important technical application in the sterilisation of water.

At the other end of the spectrum, the magnificent though invisible line at wave-length 10,140 has proved to be of unique value as a starting point for calibration work in the infra-red. It will also be remembered that some of the longest waves of light that have yet been detected were discovered by Rubens in the radiation from a mercury lamp.



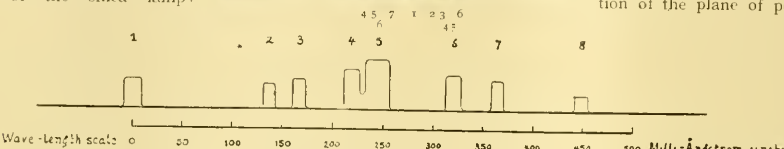


FIG. 2.—Resolution of the mercury-green line by the echelon spectroscope. The actual distribution of the components is shown by the diagram. (*By courtesy of Prof. Stansfield.*)

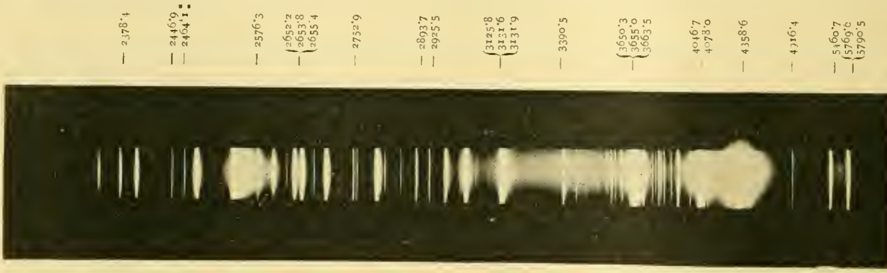


FIG. 3.—The ultra-violet spectrum of mercury. (*By courtesy of Messrs. A. Hilger, Ltd.*)

Resolution of the Mercury Spectrum.

One merit of the mercury arc as a source of light consists in the readiness with which the three main components may be separated. A direct vision prism of quite moderate dispersive power, placed in front of the eyepiece of a polarimeter, produces a separation of the three images which is sufficient for most purposes. The lines may also be separated by means of coloured screens prepared from gelatine films stained with suitable dyes.

B.—*Rotatory Polarisation.*

The phenomenon of rotatory polarisation was first discovered in the case of quartz. Arago in 1811 (Mem. Inst., 1811, pp. 93–134) found that a plate of quartz interposed between a polariser and analyser was capable of depolarising the light in such a way that transmission took place where previously there had been complete extinction. When plates of suitable thickness were used the transmitted light was no longer white, but beautifully tinted, the colour of the light varying with the thickness of the plate. Thus with increasing thickness we have progressively yellow, orange, rose-red, violet, blue, and green.

These colours were shown by Biot to be due to a rotation of the plane of polarisation, which increased (*a*) with thickness of the plate, (*b*) with change of colour from red to violet. It is therefore impossible when a beam of polarised light has passed through a quartz plate to extinguish all the colours simultaneously.

The tints which Arago observed were due to the selective extinction of light of different colours by the mirror which he used as an analyser. This selective extinction may be shown by inserting a direct vision spectroscope in front of the apparatus: the plate which produces the pale yellow colour has rotated the violet light through 180°, so that it is extinguished exactly as if no quartz plate were present; the yellow tint is the complementary colour to that extinguished. As the thickness of the plate increases, the same effect is produced with light of longer wave-length; as the extinction moves from violet to red the complementary colour changes from yellow to orange, red, blue, and green. When the bright yellowish-green is extinguished a grey "neutral tint" is produced which is extremely sensitive to small rotations of the plane of polarisation, and was at one time used very largely in polarimeters illuminated with white light.

When monochromatic light is used—as, for instance, when a green screen is placed in front of the mercury arc—the light can be extinguished completely even after it has passed through a very long column of quartz. Using green light purified by a spectroscope and rods of quartz cut from a crystal of extraordinary beauty, I have obtained a perfectly sharp extinction with a column of quartz half a metre in length, giving an actual rotation of 12,789·20° ± 0·01°. I have also been making experiments with the same material to determine accurately what rotation is produced by quartz in light of different wave-lengths, not only in the visible spectrum, but also in the infra-red and ultra-violet regions; but as the work is still incomplete, I will not attempt to describe it, but pass on at once to other ways in which rotatory polarisation may be produced.

Three years after his discovery of rotatory polarisation in quartz Biot was astonished to find that the same property was possessed by certain liquids, turpentine and laurel-oil rotating the plane of polarisation to the left, and oil of lemon and camphor (dissolved in alcohol) rotating it to the right.

In the case of quartz, Biot had attributed the rotation of the plane of polarisation to the crystalline structure of the material. The correctness of this view was proved when it was shown that rotatory polarisation no longer took place when the crystalline structure of quartz was destroyed by melting it or by dissolving it in alkali. In the case of liquids this explanation was no longer possible. Rotatory polarisation must here be attributed to some lack of symmetry in the structure of the molecule rather than of the crystal. It is in such cases that the polarimeter has proved its supreme value in the investigation of molecular structure. In this connection it will be sufficient if I refer to the classical researches of Pasteur, van't Hoff, and le Bel, and to the brilliant contemporary work of Pope, Kipling, Smiles, and Mills in our own country, and of Meisenheimer and Werner on the Continent. In each of these investigations the development of "optical activity" has been accepted as a conclusive proof of molecular asymmetry, and no firmer basis for theories of molecular structure has yet been found than that which rests upon the use of the polarimeter to detect rotatory polarisation.

C.—*Mutarotation.*

In 1846, thirty years after Biot had discovered that rotatory polarisation might occur in liquids as well as in crystals, a remarkable discovery was made by the French chemist Dubrunfaut in reference to the rotatory power of aqueous solutions of grape-sugar or glucose. Dubrunfaut found that by using freshly prepared solutions of the sugar he could observe a transient rotatory power which was twice as great as that observed in solutions which had been prepared a few hours previously. To this remarkable phenomenon he gave the name Birotation.

The same phenomenon, which is now generally known as mutarotation, has since been observed in the case of nearly all the "reducing" sugars. Many explanations were given to account for so mysterious a change, but nothing in the way of proof could, as a rule, be offered in support of these suggestions. In 1890, however, Emil Fischer discovered that similar changes of rotatory power occurred when gluconic lactone was dissolved in water and thus partially hydrolysed to gluconic acid—

$$\underset{\text{Gluconic lactone}}{C_6H_{10}O_6 + H_2O} \rightleftharpoons \underset{\text{Gluconic acid.}}{C_6H_{12}O_7.}$$

He therefore suggested that a similar explanation might be given of the mutarotation of glucose, thus—

$$\underset{\text{Glucose.}}{C_6H_{12}O_6} + H_2O \rightleftharpoons \underset{\text{Glucose hydrate.}}{C_6H_{14}O_7.}$$

Mutarotation of Nitrocamphor.

In 1896 a happy accident led to the discovery that very marked changes of rotatory power occur in freshly prepared solutions of nitrocamphor. But, unlike the case of glucose, these changes could be observed in a large range of solvents. The change varied greatly in the numerical values involved, but was always in the same direction—from left towards right.

The cause of the mutarotation was not difficult to discover. It could not be due to hydration, nor indeed to any direct chemical action of the solvent, but must be attributed to some change of structure in the molecule of the nitrocamphor itself. In view of the fact that the nitro-compound is able to simulate the properties of an acid, giving rise to strongly dextrorotatory salts, there could be little doubt that the change of rotatory power was caused by a partial conversion of the nitrocamphor into its acidic form—a conversion which can be rendered complete by the addition of alkali. This view was immediately confirmed by the discovery of a dextrorotatory anhydride, which could be prepared from nitrocamphor merely by evaporating its solutions on a water-bath.

This interconversion of isomeric compounds, which we have called dynamic isomerism, could also be used to explain the mutarotation of glucose, of which two isomeric forms are known; but there is good reason to believe that the hydrolysis suggested by Fischer is also an important factor when aqueous solutions of the sugar are under consideration.

In the case of π-bromonitrocamphor two isomeric forms of the substance can actually be isolated, thus affording direct evidence that the mutarotation observed in the case of this compound is due to a reversible isomeric change.

Form of the Curves.

In most cases the change of rotatory power proceeds according to a very simple law, the rate of change being directly proportional to the distance still remaining to be traversed.

But I have recently found a number of cases in which the curves are far more complex. In such instances it is necessary to assume a series of successive isomeric changes; but this assumption presents no difficulty, as the substances in question can all be formulated in at least five different ways.

Acceleration by Catalysts.

The mutarotation of glucose is accelerated to a moderate extent by acids and very largely indeed by alkalis. Similar observations have been made in the case of nitrocamphor. Piperidine added to a solution of nitrocamphor in benzene produces a remarkable acceleration which can be detected even at a concentration of N/10,000,000, *i.e.* 1 part in 100 million or 1 centigram per ton. Aniline is 100,000 times less active.

Arrest of Isomeric Change.

The fortunate selection of chloroform as one of a series of solvents led to the discovery of one of the most important facts that have come to light in the course of fifteen years' work on mutarotation. In the very earliest stages of the work it was found that solutions in chloroform behaved in a very irregular and surprising way; the mutarotation in this solvent seemed sometimes to "hang fire" until set going by some accidental stimulus. These observations were evidently important as proving that isomeric change was not spontaneous, even after the nitrocamphor had been dissolved. But for ten years no explanation was forthcoming to show why this phenomenon was observed in chloroform and in chloroform only. About five years ago, however, an arrest of isomeric change was again observed in the case of chloroform solutions to which a trace of acid had been added. These solutions (the rotatory power of one of which "held up" absolutely during twenty-four days) acquired a pungent and horrible odour, and had evidently undergone marked decomposition. It was not long before the odour was recognised as being due to carbonyl chloride—a well-known and (in anæsthetic chloroform) a dangerous impurity, formed by oxidation of the chloroform according to the equation—

$$CHCl_3 + O = COCl_2 + HCl.$$

This substance has the property of attacking ammonia and organic bases, such as piperidine, and converting them into neutral ureas, as shown by the equations:—

$$COCl_2 + 2NH_3 = CO(NH_2)_2 + 2HCl,$$
$$COCl_2 + 2NC_5H_{11} = CO(NC_5H_{10})_2 + 2HCl.$$

The next step was obviously to try to arrest the isomeric change by the addition of carbonyl chloride to a solvent which did not naturally contain it. This was done with marked success. A solution of nitrocamphor in purified ether showed a change of rotatory power extending over about a day; by the addition of carbonyl chloride the period was increased to eighteen days in a glass vessel, and to sixty-one days when a silica vessel (free from alkali) was used to contain the solution. In the case of benzene, to which acetyl chloride was added, the period was increased from sixteen days to sixty-four days in glass, and to two years in a silica vessel. Finally, by the addition of carbonyl chloride to a solution of nitrocamphor in benzene contained in a silica vessel the period was increased from sixteen days to six years.

Action of Light.

A convenient method of studying the effect of light on isomeric change has recently been devised in which the polarimeter plays a leading part. The solution to be studied was enclosed in a silica tube, surrounded by a silica water-jacket, and exposed to the light from a silica mercury-lamp. In seven cases out of nine, however, no acceleration whatever could be detected as a result of this extremely powerful "insolation."

I have attempted to give some account of a few instances in which polarised light has been applied to the solution of chemical and physical problems. In each case the observations have taken the form of measurements of rotatory polarisation. Measurements such as these have supplied to the chemist a key which has enabled him to unlock the strong-room in which many of the secrets of molecular structure were stored. The physicist, too, following in the footsteps of Faraday, has found in rotatory polarisation a link between the sciences of magnetism and optics, and has obtained valuable hints as to the way in which light is propagated through matter. The hundred years which have elapsed since Biot announced his great discovery have therefore served only to enhance its brilliancy, and to reveal it as one of the most illuminating disclosures even of the splendid period in which it was made.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—At Emmanuel College the following awards have been made for post-graduate research:—Studentships: W. N. Benson (petrology), 75*l*., for half-year only; J. Macdonald (the development of Plato's ethics), 120*l*.; G. Matthai (continuation of research on the comparative anatomy of corals), 150*l*. Grants from the research studentship fund: R. T. Beatty (the energy of Röntgen rays), 25*l*., for one term only; J. H. Burn (biochemistry), 50*l*.

Leeds.—Mr. E. L. Hummel has been appointed professor of mining. Mr. Hummel is a son of the late Prof. Hummel, and was educated at Leeds and in Austria. He has had much practical experience in the Yorkshire coalfield and in South Africa with the Vereeiging Estates Company.

Mr. Walter R. Crawford, of Tullyhogue, co. Tyrone, Ireland, has been appointed live stock officer for Yorkshire under the scheme for the improvement of live stock which has been inaugurated by the Board of Agriculture, with the aid of funds set aside by the Development Commissioners. Mr. Crawford has been a chief inspector under the live stock improvement scheme of the Department of Agriculture for Ireland, and is an authority on the breeding of shorthorns and on the work of milk record associations.

London.—An important correspondence between the University authorities and Lord Haldane with reference to the new site for University headquarters has been published. Lord Haldane, in a letter dated June 6, states that he is willing to try again to interest the donors who were prepared in March to acquire the Bedford Estate (British Museum) site for the University. In reply, the Vice-Chancellor raised the questions of the provision of funds for rates and taxes, and for buildings, and of securing an option for additional land in the neighbourhood for extensions. He also inquired whether it would be possible to close the central road between the buildings to traffic. Lord Haldane, in a letter dated July 13, was able to give satisfactory assurances on these points. The sites committee of the University have decided to postpone further consideration until a conference is arranged with the London County Council.

At the meeting of the Senate on July 16, the D.Sc. degree was granted to Mr. J. C. Chapman (King's College) for a thesis on secondary Röntgen radiation; to Dr. G. C. McK. Mathison (University College) for a thesis on the action of asphyxia upon nerve centres; and to Mr. J. Johnstone for a thesis entitled "Tetrarhynchus Erinaceus, van Beneden I., Structure of the Larva and Adult Worm."

Sir Harry Waechter has offered 300*l*. a year for five years for a department for the treatment of disease by vaccine therapy at University College Hospital.

Grants amounting to 375*l*. for 1913–14 have been made to the following out of the Dixon Fund, for the assistance of various researches:—The Brown Animal Sanatory Institution, Prof. G. Barger, Mr. Morley Dainow, Mr. P. E. Lander, Miss Constance Leetham, Dr. Martin Lowry, Dr. Geoffrey Martin, Mr. J. W. McLeod, and Mr. J. A. Pickard.

Prof. John Laird, professor of logic in the Dalhousie University, Halifax, Nova Scotia, has been appointed to the chair of logic and metaphysics in the Queen's University, Belfast, in succession to the late Prof. Park.

An anonymous donor has given 500*l.* to the South-Eastern Agricultural College, Wye, for the extension of the research department, and the Development Commission is recommending a grant of 6000*l.* for the completion of the new college buildings. The governors have decided upon the erection of the buildings at the Fruit Research Station at Malling, the land for which (twenty-two acres) has been purchased by the Kent County Council.

The following benefactions, among others, we learn from *The Times,* have been left to the British Academy by the late Miss Henriette Hertz:—2000*l.* for an annual lecture, investigation, or paper on a philosophical problem, or some problem in the philosophy of Western or Eastern civilisation in ancient and modern times bearing on the phenomena of life in relation to eternity; 1000*l.* for an annual public lecture on some master mind, considered individually with reference to his life and work, specially in order to appraise the essential elements of his genius, the subjects to be chosen from the great philosophers, artists, poets, musicians; and 1000*l.*, the income of which is to be used to promote the publication of some philosophical work or to reward some meritorious publication in the department of philosophy. Miss Hertz also left the sum of 1500*l.* to Girton College, the income to be used for the endowment of archæological research.

The Board of Agriculture and Fisheries has awarded research scholarships in agricultural science of the annual value of 150*l.*, tenable for three years, to the following candidates, viz.:—E. W. Barton (Wales), economics of agriculture; W. Brown (Edinburgh), plant pathology; Miss E. C. V. Cornish (Bristol), dairying; F. L. Engledow (London), genetics; E. J. Holmyard (Cambridge), plant nutrition and soil problems; R. C. Knight (London and Bristol), plant physiology; F. J. Meggitt (Birmingham), agricultural zoology; H. Raistrick (Leeds), animal nutrition; G. O. Sherrard (Dublin), genetics; T Trought (Cambridge), genetics; G. Williams (Wales), animal nutrition; S. P. Wiltshire (Bristol), plant pathology. The Board has also awarded Miss T. Redman (London), a scholarship in dairying, tenable for two and a half years, to fill a vacancy caused by the resignation of a former scholar. The scholarships have been established in connection with the scheme for the promotion of scientific research in agriculture, for the purposes of which the Treasury has sanctioned a grant to the Board from the Development Fund; they are designed to provide for the training of promising students under suitable supervision with a view to enable them to contribute to the development of agricultural science.

The May issue for this year of the *Johns Hopkins University Circular* takes the form of the University Register for 1912–13. The volume contains an interesting historical introduction, which points out that the Johns Hopkins University was founded by a merchant of Baltimore, Johns Hopkins, who bequeathed the greater part of his estate for the establishment of a university and a hospital. The University was incorporated on August 24, 1867. Instruction began in 1876, in which year President D. C. Gilman, from the University of California, was appointed first president, and remained in office for twenty-five years, being succeeded in 1901 by President Remsen, who resigned last year. The original endowment of the University amounted to somewhat more than 600,000*l.* This has been supplemented by several gifts, including the Endowment Fund of 1902 (200,000*l.*), the John W. McCoy Fund (100,000*l.*), and the Garrett Fund of 60,000*l.*, in addition to many other large sums. The income-bearing funds have a book value of more than 1,000,000*l.*, and the real estate and buildings, books, scientific apparatus, and general equipment are valued at more than 450,000*l.* The assets of the University have thus a total value of a million and a half sterling. By Act of the Legislature of Maryland, at its session of 1912, the sum of 120,000*l.* was granted for the purpose of constructing and equipping buildings for a school of technology as a department of the University, with an annual appropriation of 10,000*l.* for maintenance.

The Government's education policy was outlined by Mr. J. A. Pease, President of the Board of Education, in introducing in the House of Commons on Tuesday a "Bill to amend the law in respect to grants in aid of building, enlarging, improving, or fitting up elementary schools." In the course of his remarks, Mr. Pease said that the defects of our so-called national system of education are two—it is not national and it is not a system. The age at which compulsory attendance at school ceases under the existing law is too early; and to allow children to leave school at the age of from twelve to fourteen years, and leave them to forget what they have learned, is to neglect national responsibility. One main purpose of the Government is to organise intermediate education—that is, all classes of education from the elementary school and the university—by extending the powers and duties and adding to the resources of local education authorities. Further duties of these authorities must be accompanied by further and substantial assistance from the State. Out of 29,834,000*l.* spent on education in 1911–12, 14,186,000*l.* was obtained from the rates and 13,648,000*l.* from Exchequer grants. The increase in expenditure since 1905–6 has been 3,500,000*l.* drawn from the rates and 1,000,000*l.* from grants, or out of every additional 9*l.* required in the last six years 7*l.* had been found by the ratepayers and 2*l.* by the taxpayer. The demand which the ratepayer has for further relief for the taxpayer must, therefore, be admitted. As regards higher education, there will be no interference with the independence of the universities or with the government of training and technical colleges. The principles of the proposed legislation will be the arbitrary provision of intermediate education for all who desire it, placing it within the reach of all classes, and the coordination of such provision between authorities to prevent overlapping. Local authorities will have the duty imposed upon them of affording children during the latter years of elementary-school life opportunities of obtaining such instruction of a more advanced character than that given in the ordinary public elementary schools as may be thought suitable to the circumstances of the children. For this purpose the limit imposed by the Act of 1902 on the amount that might be raised by way of rates for the purposes of higher education will be removed. To give effect to the proposals of the Government, will require a large and substantial addition to the sum at its disposal, which will rise progressively from the first, second, third, and subsequent years. The forecast, of which no details can yet be given, includes provision for the universities, provision for the reconstitution of London University, and provision for the maintenance of increased secondary and technical schools.

SOCIETIES AND ACADEMIES.

Dublin.

Royal Irish Academy, June 23.—Dr. F. A. Tarleton in the chair.—**H. Ryan** and Rev. **J. M. Dunlea**: Unsaturated diketones. I. By the condensation of cinnamic ester with acetone, acetophenone, methyl-ethyl-ketone, and isopropyl-methyl-ketone, the unsaturated β-diketones, cinnamoyl-acetyl-methane, cinnamoyl-benzoyl-methane, cinnamoyl-propionyl-methane, and cinnamoyl-*iso*butyryl-methane were synthesised, and their structural properties examined.—H. **Ryan** and J. **Algar**: Unsaturated diketones. II. Although benzylidene-acetone does not condense to a β-diketone with benzoic ester in the presence of sodium it reacts readily with dimethyl oxalate. Similarly anisylidene-acetone condenses to a β-diketone with dimethyl oxalate. The diketones formed isoxazols with hydroxylamine hydrochloride, and behaved as weak mordant dyes.—G. H. **Carpenter**: Aptera, in connection with the Clare Island Survey. Eighteen species of Collembola and two of Thysanura are recorded from Clare Island, and the apterygotan fauna is found to present, on the whole, an Arctic and American facies. One of the commonest insects on the island and neighbouring mainland is *Petrobius maritimus*, Leach. Some details of the external anatomy of this species are given, and it is shown that the Dutch shore-haunting bristle-tail described by Oudemans, and called *Machilis maritima*, is entirely distinct from the British and Irish insect named by Leach.—W. M. **Tattersall**: Amphipoda, in connection with the Clare Island Survey. The number of species recorded in this paper from the Clare Island marine area is ninety-five. No new species are described, but nineteen species are added to the Irish list for the first time, and fifty-four species are new to the area under review. The Amphipoda of Clare Island include thirty-three Arctic species and sixty-two non-Arctic. Of the former, fourteen extend to the Mediterranean and twelve to the coasts of America. Of the non-Arctic forms, twenty-five are found in the Mediterranean, a further twenty-one are confined to the Atlantic coasts of Europe from Norway to France. Six species are common to the British area and the Mediterranean, but do not extend to Norway. A further ten species are confined to the waters of the British area and neighbourhood, and are unknown from both Norway and the Mediterranean.—R. **Southern**: Nemertinea, in connection with the Clare Island Survey. The total number of species found in the Clare Island area was thirty-one. Of these, two species, *Lineus acutifrons* and *Prostoma beaumonti*, were described as new. *Tubulanus banyulensis*, Joubin, was added to the British fauna, and seven other species were obtained which had not previously been recorded from Ireland. The Nemertean fauna as a whole closely resembles that found in the south-west of England.

Royal Dublin Society, June 24.—Prof. H. H. Dixon, F.R.S., in the chair.—Miss M. C. **Knowles**: Maritime and marine lichens of Howth (Dublin Bay). Altogether 180 species are recorded from the Howth coasts in this paper, of which three are now described for the first time, and twenty-three are new to Ireland. An attempt has been made to give an account of the lichen vegetation from an ecological as well as from a systematic point of view, and the various species are described as growing in the following succession of belts from the top of the cliffs to low-water mark:—(1) The Ramalina belt; (2) the belt of orange lichens; (3) the Lichina vegetation; (4) the *Verrucaria maura* belt; (5) the belt of marine Verrucarias. The composition of each belt is given in detail.—Prof. G. H. **Carpenter**: Injurious insects and other animals observed in Ireland during the year 1912. The very hot, dry summer of 1911 led to an excessive abundance of insects in the spring of 1912, from the depredations of which orchards and fruit-trees suffered heavily. "Greenfly" on apple-trees were especially abundant, and two distinct kinds of Aphis occurred in many parts of Ireland. Referring to the "woolly aphid," or "American blight," attention was directed to a new mode of wintering for the insects—inside the cores of apples, several of which, imported from America and sold in Dublin, were found to be infected in this way. Introduction of the pest into fresh localities might thus be brought about.—W. R. G. **Atkins**: Oxydases and their inhibitors in plant tissues. The distribution of oxydases seems to point to their being concerned in the production of cork and sclerenchyma. The guard cells of stomata and the cells abutting on them are particularly rich in "epidermal" oxydase, while the abutting cells may also contain the bundle oxydase of Keeble and Armstrong. The leaf-saps of *Iris germanica* and *Aspidium Filix-mas* contain powerful reducing substances which inhibit oxydase reactions. Precipitation of the enzymes by alcohol or removal of the reducing substance by dialysis permits of the detection of oxydase. The colours of the perianth of Iris are due to the presence of a yellow plastid pigment or of a purple anthocyan chromogen which arises by the action of the epidermal peroxydase on a chromogen. The reducing substance may inhibit colour production.—Dr. W. E. **Adeney**: The "streaming" of dissolved atmospheric gases in water. Part i. In this communcation there are given the results of an experimental investigation of the rates at which atmospheric nitrogen and oxygen are dissolved by the exposed surfaces of quiescent columns of de-aërated fresh- and sea-water, and the rates at which the dissolved gases are transmitted downwards through the columns under the conditions: (1) when evaporation can freely take place from the exposed surfaces of the columns, and (2) when it cannot, the columns of water being maintained at a uniform temperature. The determinations have been made for temperatures varying between 8° and 20° C. Descriptions of special apparatus for the rapid extraction of the dissolved gases from water, and for their analysis, are also given.

EDINBURGH.

Royal Society, June 2.—Sir William Turner, K.C.B., president, in the chair.—Sir William **Turner**: Contributions to the craniology of the people of the Empire of India. Part iv. The author described and compared a number of skulls from the Bhils, frontier tribes of Burma and Pakkoku, South Shan tribes, and Tibetans.—Dr. J. H. Harvey **Pirie**: Scottish National Antarctic Expedition, glaciation of the South Orkneys. This was a full account of a careful survey made by Dr. Pirie when wintering at the South Orkneys. These glaciers are either of the "ice-foot" or of the "Spitsbergen" type, according to Nordenskjöld's classification. Their movement and erosive powers are very slight, and they are at present much less extensive than at former times.

June 16.—Dr. B. N. Peach, vice-president, in the chair.—Dr. J. G. **Gray**: New models of gyrostats. When large rotational speeds are employed, the fly-wheels must be perfectly balanced. Some of those exhibited could be run up to 30,000 revolutions per minute. The largest size, when spun at 15,000 revolutions per minute, continued to revolve for forty-five minutes. Among the many curious devices shown was the model of a motor-car running on two wheels placed in tandem. The car was stable, both when at rest or when in motion. When in motion the car derived its stability from the propelling system. The gyrostat detected any tendency to tilt over and immediately applied to, and obtained from, the propelling system just the forces required to correct the tendency. This force disappeared precisely when its existence was no longer needed, so that the contrivance was entirely free from gyrostatic oscillations. The model was shown moving slowly about the room under the direction of an electromagnetic driver seated on the car and controlled by a switch on the lecture table. The driver could also be operated by wireless transmission.

July 7.—Dr. J. Horne, vice-president, in the chair.—S. D. **Carothers**: Plane strain in a wedge with application to masonry dams. The equations of equilibrium for plane strain were applied to a sector of an infinite right cylinder bounded by two planes through the axis, when the plane faces were subject to various conditions of pressure, which was either constant or varying as the distance from the axis. The several appropriate solutions were combined with the solution appropriate to the case in which the body forces were considered so as to obtain a solution applicable to the case of a masonry dam. The displacements were worked out for one case.—Prof. J. Stanley **Gardiner**: The corals of the Scottish National Antarctic Expedition. Five species were described, of which one, referred to genus Madracis, was new. It was dredged off the Abrolhos Bank.—Dr. W. M. **Tattersall**: The Schizopoda, Stomatopoda, and non-Antarctic Isopoda of the Scottish National Antarctic Expedition. Of Schizopoda twenty-four species were recorded, including one new species of Boreomysis. The Stomatopoda were represented by one species of Squilla and three larval forms of Lysiosquilla; and of the eighteen species of Isopoda recorded, three were new, two of Exosphæroma, and one of Antarcturus.—Dr. J. H. **Ashworth**: Some pseudo-hermaphrodite examples of *Daphnia pulex*. The specimens were undoubted females, but in each the antennule of one side resembled that of a male, and in one case also one of the valves of the carapace had a configuration similar to that of a male. In all other features, both external and internal, the specimens exhibited female characters. The offspring of two of the specimens were available for examination, and proved to be entirely normal—that is, the structural peculiarities of the antennule were not transmitted.

PARIS.

Academy of Sciences, July 15.—M. F. Guyon in the chair.—J. **Boussinesq**: The theory of Savart's retractile liquid sheets.—Armand **Gautier** and P. **Clausmann**: Fluorine in the animal organism, brain, glands, muscles, blood, milk, excretions. Fluorine exists in all animal organs and tissues, but in very varying proportions. Excluding organs not completely formed in very young animals, and the excretions, there is a relation between the amounts of fluorine and phosphorus present; the two increase together without being proportional. The dental enamel has the highest proportion of fluorine, 180 to 118 milligrams in 100 grams of dry material; muscle has the smallest amount, 0·6 to 0·15 milligram in 100 grams of dry material. In man about 1 milligram of fluorine is excreted per day, and as the fluorine taken with the food is considerably greater than this figure, the difference represents epithelial desquamation, hair and nails, &c.—H. **Block**: The energy of nebulæ and Carnot's principle. A discussion of the theory of Arrhenius and an extension of some recent calculations on this subject by Schwarzschild.—Kr. **Birkeland**: The general magnetism of the sun.—M. **Robinson**: Systems of partial differential equations.—Th. **Anghelutza**: A generalisation of Riemann's summation.—M. **Ariès**: Remarks on a form of the velocity of propagation of sound in a homogeneous fluid.—Thadée **Peczalski**: New forms of the characteristic equations of gases.—Marcel **Boll**: The influence of the wave-length on the velocity of a photochemical reaction. A formula is given, based on experimental results, expressing the velocity of a reaction as a function of the thickness of the layer, concentration, coefficient of absorption, power and frequency of the incident radiation. The wave frequency acts in a manner analogous with temperature in ordinary chemical reactions.—M. **Blanchetière**: Oxidation and luminescence. A large number of substances have been examined for the production of luminescence on oxidation. The phenomenon was marked with lophine, amarine, hydrobenzamide, extracts of meat, urine, tea. The question as to the exact nature of the organic complex the oxidation of which results in luminescence was not solved.—S. **Wologdine**: The heats of formation of some silicates of iron and manganese.—Paul **Braesco**: The baking of clays.—Victor **Henri** and René **Wurmser**: The action of ultra-violet rays on solutions of hydrogen peroxide. The velocity of decomposition of hydrogen peroxide in monochromatic light is proportional to the concentration, to the incident energy, and to the energy absorbed. Einstein's law of photochemical equivalence does not apply to this reaction. The energy which is absorbed by the decomposition of a gram-molecule of hydrogen peroxide is sensibly equal to the energy evolved by the decomposition of the same quantity in the dark.—Daniel **Berthelot** and Henry **Gaudechon**: Addition reactions between carbon monoxide and other gases under the influence of the ultra-violet rays. Carbon monoxide, under the action of ultra-violet light, combines with chlorine, oxygen, water, ammonia, but not with bromine, iodine, sulphur, sulphuretted hydrogen, phosphine, arsine.—Léo **Vignon**: The formation of methane by catalysis, starting with carbon monoxide and water vapour. Details of experiments with iron, nickel, copper, and their oxides, silica, alumina, and magnesia, as catalysers at temperatures ranging from 300° C. to 1250° C.—H. **Gault**: The lactonisation of the α-ketonic esters.—Paul **Lebeau** and Marius **Picon**: The action of sodammonium on the true acetylenic hydrocarbons of the fatty series, and on a mode of formation of ethylenic hydrocarbons. Sodammonium reacts with the acetylenic hydrocarbons of the fatty series, giving the sodium derivative of these hydrocarbons and the corresponding ethylenic hydrocarbon in the proportion of one molecule of the ethylene to two molecules of the sodium derivative. The products of the reaction are very pure, and no secondary reactions were observed.—L. **Bounoure**: The influence of the size of insects on the production of chitin. The mean thickness of the chitin layer is constant, or the quantity of chitin is proportional to the secreting surface.—Edouard **Chatton**: *Orchitosoma parasiticum*, a parasite with three rudimentary leaflets of *Paracalanus parvus*.—E. **Faure-Fremiet**: The action of the ultra-violet rays on the egg of *Ascaris magnalocephala*.—Charles **Nicolle**, A. **Conor**, and E. **Conseil**: Intravenous inoculation of some living typhoid bacilli.—Gabriel **Bertrand** and Robert **Sazerac**: The favourable action exercised by manganese on the acetic fermentation. The power of the organism of transforming alcohol into acetic acid is strongly accelerated by the addition of a certain proportion of manganese; the acceleration increases at first as the amount of manganese increases, then passes a maximum.—R. **Fosse**: The presence of urea in the invertebrates and in their excretion products.—Jules **Ventre**: The influence of the yeasts and the initial constitution of the musts on the acidity of fermented liquids.—André **Mayer** and Georges **Schaeffer**: Researches on the lipocytic constancy. The proportion of lipoids containing phosphorus in the tissues.—M. **Repelin**: The geology of Sainte-Baume.

CALCUTTA.

Asiatic Society of Bengal, July 2. F. F. **Laidlaw**: Note on the dragonflies of Syria and the Jordan Valley. The dragonflies of Syria and the Jordan Valley are still imperfectly known, but at least two geographical elements may be distinguished among them a Mediterranean element, and a tropical one, African in its main features, but also showing certain affinities with the Oriental fauna.—Dr. N. **Annandale** and S. W. **Kemp**: The Crustacea Decapoda of the Lake of Tiberias. Three species of Decapoda are known from the Lake of Tiberias and its immediate vicinity, viz. the crab *Potamon potamios*, and the prawns *Atyaëphyra desmarestii* and *Typhlocaris galilea*. The last occurs only in one small isolated pool, and is remarkable on account of its degenerate eyes and uniform white coloration, as well as for certain structural characters which separate it from all other Caridea.

BOOKS RECEIVED.

Bacon's New Contour Map of the Near and Middle East (The Land of the Five Seas). (London: G. W. Bacon and Co., Ltd.) 7*s*. 6*d*.

Der Stoffwechsel der Pflanzen. By O. Stocker. Pp. iii+60. (Leipzig and Berlin: B. G. Teubner.) 2 marks.

Expedition Antarctic Belge. Resultats du Voyage s.y. *Belgica* en 1897–8–9. Rapports Scientifiques. Zoologie. Tuniciers, Caducichordata (ascidiaces et Thaliaces). By E. van Beneden and M. de Selys-Longchamps. Pp. 119+xvii plates. Geologie. Petrographische Untersuchungen der Gesteinsproben. By D. Sistek. II. Teil. Pp. 20+plate. (Anvers: J. E. Buschmann.)

The Journal of the Institute of Metals. Vol. ix. Pp. ix+333. (London: Institute of Metals, Caxton House.) 21*s*. net.

The Journal of the Municipal School of Technology, Manchester. Vol. vi. Pp. 277. (Manchester: Municipal School of Technology.)

The Princeton Colloquium. Lectures on Mathematics delivered September 15 to 17, 1909 before Members of the American Mathematical Society, in connection with the Summer Meeting held at Princeton University, Princeton, N.J. By G. A. Bliss and E. Kasner. Pp. v+107+ii+117. (New York: American Mathematical Society.)

Library Cataloguing. By J. H. Quinn. Pp. viii+256. (London: Truslove and Hanson, Ltd.)

The Under Dog. Edited by S. Trist. Pp. xv+203+v. (London: *The Animals' Guardian*.) 3*s*. 6*d*.

The Proceedings of the Optical Convention, 1912 held at South Kensington, June 19 to 26, 1912. Vol. ii. Pp. vii+359. (London: University of London Press; Hodder and Stoughton.) 10*s*. net.

Ce que j'ai vu chez les Bêtes. By P. Noël. Pp. 343. (Paris: A. Colin.) 3.50 francs.

An Introduction to the Mathematical Theory of Attraction. By Dr. F. A. Tarleton. Vol. ii. Pp. xi+207. (London: Longmans and Co.) 6*s*.

Industrial Poisoning from Fumes, Gases, and Poisons of Manufacturing Processes. By Dr. J. Rambousek. Translated and edited by Dr. T. M. Legge. Pp. xiv+360. (London: E. Arnold.) 12*s*. 6*d*. net.

The Mineral Kingdom. By Dr. R. Brauns. Translated, with additions, by L. J. Spencer. Parts 23, 24, 25. (Esslingen a.N.: J. F. Schreiber; London: Williams and Norgate.) 2*s*. net per part.

An Account of the Crustacea of Norway. By G. O. Sars. Vol. vi., Copepoda, Cyclopoida. Parts i. and ii. Pp. 32+xvi plates. (Bergen: Bergen Museum.)

A Manual of School Hygiene. By Prof. E. W. Hope, E. A. Browne, and Prof. C. S. Sherrington. New edition. Pp. xii+311. (Cambridge University Press.) 4*s*. 6*d*.

Evolution by Co-operation. By H. Reinheimer. Pp. xiii+200 (London: Kegan Paul and Co., Ltd.) 3*s*. 6*d*. net.

Hull Museum Publications. No. 94. A List of the Seventeenth-Century Tokens of Yorkshire. By T. Sheppard. Pp. 27–59. (Hull: The Museum.) 1*d*.

Plant Life. By Prof. J. B. Farmer. Pp. viii+255. (London: Williams and Norgate.) 1*s*. net.

Toadstools and Mushrooms of the Countryside. By E. Step. Pp. xvi+143+plates. (London: Hutchinson and Co.) 5*s*. net.

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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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PROF. PERRY'S PRACTICAL MATHEMATICS.

Elementary Practical Mathematics. With Numerous Exercises for the Use of Students, and especially of Mechanical and Electrical Engineering Students. By Prof. John Perry, F.R.S. Pp. xiv + 335. (London: Macmillan and Co., Ltd., 1913.) Price 6*s.*

DURING the past ten or fifteen years a great deal of work has been done by mathematical teachers in wiping old scores off the slate and redeveloping their teaching on more sensible and rational lines. It is well known that this revolution owes its success largely to the indefatigable exertions of Prof. John Perry. We cordially agree with many of the remarks contained in the preface to the present book. It is impossible to quote the whole of the author's attacks on the old-fashioned drudgery in algebra which has disgusted many would-be mathematicians in the past, and made it quite impossible for the present reviewer ever to appreciate anything but applied mathematics. We can only quote the first few lines:—

"Academic methods of teaching mathematics succeed with about five per cent. of all students, the small minority who are fond of abstract reasoning; they fail altogether with the average student. Mathematical study may be made of great value to the average man if only it is made interesting to him."

Now one difficulty that most teachers have experienced in developing mathematics on more rational lines has certainly been the difficulty of constructing suitable exercises, examples, and examination questions. It is not that it is intrinsically more difficult to construct practical questions than it was to devise the old "pretty" question to the effect that "if tweedledum" (meaning one jumbled mass of symbols) "shew" (never show) "that tweedledee" (an equally meaningless formula). Still, to stock a book with practical intelligent questions is so difficult a task that the author's statement, "In many cases each of the questions has taken several hours, and in some cases several days, to construct," will be well understood by everyone who has worked or tried to work on similar lines.

If Prof. Perry had only published his collection of questions under the title "Exercises in Practical Mathematics," we should have given the book our unqualified praise. Unfortunately, however, when he comes to deal with *bookwork*, we fail to find much difference between his "practical" mathematics and the old-fashioned "academic" mathematics, except that his methods are less logical, less interesting, and less convincing than those now adopted by our best teachers.

In fact, most of the bad features of our existing methods of teaching, which the author so violently attacks in his preface, will be found reproduced in his own text. The book, to some extent, resembles a recent volume which might be called "The Fool's Calculus," and which justified this title from the way the author had made an easy subject appear difficult. Let us now examine a few points in detail.

Prof. Perry is quite correct in saying that "when calculating from observed quantities it is *dishonest* to use more figures than we are sure of," although, perhaps, this mistake might be rather described as "unmathematical inaccuracy," than as dishonesty. But the only remedy he can suggest in the case of contracted multiplication is to multiply by 8651 when he wants to multiply by 1568. Very few teachers adopt this absurd and unnecessary method. A boy who has any common sense ought to learn not only to multiply numbers the right way round, but to be able to fix the position of the decimal point in any line of the products.

His definition of a logarithm is as follows:—

"If $a^n = N$ then $n = \log_a N$ and we read this as 'n is the logarithm of N to the base a.'"

Now the average schoolboy ought to learn to multiply and divide by means of a table of logarithms long before he knows what is the meaning of a^n. Besides, the definition is not a logical one unless n is a positive integer, because the very existence of quantities with fractional indices depends for its proof on the existence of a system of logarithms. By making up successive integral powers of 1·01 or 1·0001 or 1·0000001, we can prove the existence of logarithmic scales capable of performing numerical calculations to any required degree of accuracy, and these lead to the conception of the natural scale. Prof. Perry then says that "in many important calculations we need to use Napierian logarithms, whose base is 2·71828." "Why 2·71828?" asks the intelligent student. No answer is given; and this is what Prof. Perry calls "practical mathematics." We should call it cram. But the author continues to drag in this apparently useless and meaningless symbol e throughout the book, and when it occurs in such examples as the following (p. 30):—

"If $\log_e \frac{853}{493} + 0{\cdot}9 \times \frac{836}{853} = \log_e \frac{677}{493} + \frac{961}{677}x$, find the value of x to three significant figures"

Z

—we fail to see the superiority of Prof. Perry's questions over the worst examples of the old Cambridge school.

A very few lines of explanation, based on the definition as a limit, would make the student take an intelligent interest in e. But having started on the wrong tack, Prof. Perry, on p. 150, fails to find a satisfactory proof of the differentiation formulæ involving e without assuming the exponential series, and by the time he uses the formulæ, on p. 189, it is too late to exhibit the significance of this important limit. An intelligent boy ought to be able to understand the compound interest law and the ordinary differentiation formulæ long before he learns how to differentiate the infinite series employed in Prof. Perry's proof. Take next the formula for the belt slipping on the pulley (p. 37). The formula $N/M = e^{\mu\theta}$ conveys no meaning to the student of average intelligence, and it is not the method that anyone with common sense would employ in experimental work. What he would do would be to use the formula $N/M = c^n$, where c is a constant and n the number of turns, c being found by experiment.

The same mistake is made with the radian. Prof. Perry (p. 62) expects his students to be as ready to *think* in *radians* as in degrees, but he conspicuously fails to impress his readers sufficiently with the *utility of the radian* in connection with the relation between angular and linear velocity and differentiation formulæ.

The chapter on algebra is a good feature, if for no other reason than the fact that existing text-books on algebra are still so unsatisfactory. The proper method of introducing algebra is in connection with the *use of formulae*, and the converse use of formulæ naturally leads to the problem of *solving an equation*. In the conventional treatment the utility of the subject is completely ignored, and the study is presented in the form of hateful drudgery. But here, again, Prof. Perry lays stress on such problems as, "Divide a number into two parts," or "A father is 3·5 times as old as his son," of which we have had too many already.

In the chapters on mensuration, squared paper, and important curves, Prof. Perry is working on what is now well-known ground; at the same time his treatment is in many respects unsatisfactory, particularly in connection with curves. Thus we all know the importance of the cycloid in geometry, mechanics, and physics. But all that Prof. Perry does is to make the student plot this curve on squared paper by means of the equations $x = a(\phi - \sin\phi)$ and $y = a(1 - \cos\phi)$. When this is done the student knows nothing whatever about what a cycloid really is. An intelligent boy should learn to plot curves not only from their equations, but from their geometrical definitions; and, further, he should be trained to plot envelopes as well as loci. The mere drawing of graphs may easily degenerate into unintelligent drudgery quite as objectionable as any of the old algebraical drill of our schooldays. What is the use of asking boys such questions as the following?

"Find a value of x to satisfy

$$5{\cdot}3\, e^{0{\cdot}104x} \sin^2 0{\cdot}8x + 0{\cdot}78x^{1{\cdot}52} \cos x - 2{\cdot}126 = 0.$$

"The student must remember that $0{\cdot}8x$ is in radians, and must be multiplied by 57·296 to convert it into degrees. Ans. $x = 0{\cdot}74$."

In the sections on the calculus there is not very much fault to find with the practical illustrations, and, indeed, most of them are based on fairly reasonable views. But when the author comes to establishing differentiation formulæ he falls into the error of defining a differential coefficient as the limit of

$$\frac{f(x+\delta x) - f(x)}{\delta x},$$

instead of regarding it as the limit of

$$\frac{f(x_2) - f(x_1)}{x_2 - x_1},$$

when x_2 and x_1 both approach a common limit x, which may or may not be taken to be equal to either x_2 or x_1. Consequently he introduces higher powers of δx, which he afterwards has to neglect, and which ought never to have come in. The alternative definition here suggested leads at once to Lagrange's remainder theorem in the form,

$$f(x_2) = f(x_1) + (x_2 - x_1)f'(x),$$

where x has some value between x_1 and x_2.

The result is that in differentiating x^n Prof. Perry assumes the binomial theorem plus certain other assumptions not stated, whereas any pupil ought to differentiate x^n long before he has heard of the binomial theorem. In speaking of limits Prof. Perry says:—

"The plain man of common sense finds no difficulty in catching the idea. Two thousand years ago neither he nor a small boy would have had a difficulty in understanding that a hare would beat a tortoise in a race; it is the mathematical philosopher who makes a difficulty about such matters, and in these days he says that this fundamental idea of the calculus can only be comprehended by a mathematician. This would not matter if these philosophers were not entrusted with the education of youth, a trust for which all their training has unfitted them. When they come to explain the essential idea of the limiting value of $\delta s/\delta t$, they talk foolishly."

Readers of "Elementary Practical Mathematics" will have no hesitation whatever in endorsing this statement!

While a great many notions are introduced into the text in such a way as to make them appear useless, uninteresting, and unintelligible, many of the most important points in a rational system of mathematical education receive little or no attention. Take the broad, general notion of a function, so simple that it can be explained to anyone who is sufficiently unmathematical to understand common sense. It is well illustrated in the case of the senior wrangler who entered the Stock Exchange and began to apply algebraic methods to the money market. He failed because he had omitted to take account of political considerations. Here was a case where the result was a function of a number of variables, and he treated some of these variables as constant. The senior wrangler was not sufficient of a mathematician. The mere failure to enumerate all the variables in a function occurring in everyday life represents a national loss of millions per annum. Prof. Perry says:—

"I must confess, however, that the compilers of modern school algebras must make the gods laugh over the uses to which they put this plotting of functions."

They certainly will do so when they read this book.

All this is a very great pity. Most modern matnematical teachers are only too glad to get "formula" questions for their pupils dealing with beams, expansion of steam, flow of water through pipes, electrical resistances, and other practical considerations which familiarise the student in the use of algebraic formulæ and equations. We believe they *can* get the questions they want from this book, and, on the other hand, when it comes to methods of teaching, every teacher naturally prefers his own. But if the substance of the text is a fair indication of what is meant by "practical mathematics," we agree with Prof. Perry's remark (p. xiii.), which, when quoted without its context, reads to the effect that

"The subject of practical mathematics is, I am happy to say, a subject which is not likely to commend itself to such institutions, nor are such text-books likely to be of much use to real students."

Evidently neither "academic" nor "practical" mathematics supplies exactly what is wanted. They both have one fault in common, namely, that they place difficulties before the student without any rhyme or reason. Mathematics is not in itself difficult or uninteresting; a child of three can invent a theory and notation for minus quantities without any assistance, help, or encouragement whatever. What we want is a subject that might be better described as "common-sense mathematics." Teachers are striving after this ideal, and it is very valuable and important to see clearly, as this book shows, that for the attainment of this ideal something more than "practical" mathematics is necessary.

G. H. BRYAN.

AN EGYPTIAN DESERT.

The Geography and Geology of South-eastern Egypt. By Dr. John Ball. (Survey Department of Egypt, Cairo.) Pp. 394. With Maps and many Illustrations.

THE area described in this latest monograph issued by the Geological Survey of Egypt is the southern part of the Eastern Desert—a district little known, and inhabited only by nomad Arabs of the Ababda and Bisharin tribes.

From north to south, this country is intersected by a mountainous axis which rises to heights of from 3000 to more than 5000 feet, and consists mainly of granite, diorite, gabbro, and other plutonic rocks. Eastward from this axis a series of Wadys run down, somewhat steeply, to the shores of the Red Sea on the east, these shores being almost everywhere bordered by coral reefs, which render the coast one of the foulest in the world for shipping. Westward from the mountain axis another series of Wadys lead down more gradually to the basin of the Nile. Dr. Ball, who is an accomplished surveyor as well as a geologist, has been able to add much to our knowledge of the physiography and scenery of this almost unexplored country. While devoting his chief attention to the geological features of the district—his discussion of the petrology being especially full and well illustrated—the author has been able to supply much new and interesting information concerning the antiquities, the plant and animal life, and the inhabitants—their languages, industries, and customs.

From a very early period the district has been credited with the possession of considerable mineral wealth, especially famous having been its gold-mines and emerald workings. Dr. Ball's researches, however, do not give much support to the belief that the district may in the future become a great mining centre.

It is true that very numerous small workings scattered all over the country show how wide and persistent has been the search for gold within the area. There do not appear to have been any alluvial workings, but numerous quartz veins, intersecting all the crystalline rocks of the district, sometimes containing calcite with ores of copper and iron, yield minute quantities of gold, the particles of which are seldom visible. In small handmills of diorite this quartz appears to have been ground up and the gold extracted from it, but this appears to have been only profitable when done by convict labour. Prospectors in modern times, guided by the presence of these old workings, have attempted to carry on the extraction of the gold on a larger scale by modern methods, but only in a few cases has it been found that this can be done with profit, and most of the concessions have been surrendered.

The once-famous emerald-workings of Zabara and Sikait in this district are opened in masses of mica-schist, which alternate with gneiss, and contain crystals of tourmaline and beryl—the clear green varieties of this latter mineral constituting the valuable gem emerald. It would appear, however, that the ancients were satisfied with specimens which, owing to their clouded or flawed characters, do not appeal to the jewellers of the present day, and, extensive as the old workings undoubtedly were, there appears to be little chance of the industry being revived.

At several points on the Red-Sea coast, deposits of gypsum and anhydrite, with pockets of sulphur, occur, and concessions for the working of the latter mineral have been granted.

One successful mining industry, however, would appear to be in full operation in the little island of Tuberged, or St. John's, lying out in the Red Sea, forty or fifty miles from the coast. Here, in the midst of serpentine rocks, numerous beautiful crystals of peridot (oliome) are obtained, and the work of exploitation is being successfully carried on.

But although the expectations that this desert region might become a centre of a great mining industry do not seem likely of fulfilment, the district is not devoid of interest to the man of science. The rocks of the country exhibit, as shown by Dr. Ball, a very great variety and not a few remarkable characters, and the book before us, with its abundant photographic and other illustrations, is well worthy of the attention which it cannot fail to attract. J. W. J.

THE PROBLEM OF A PURE MILK SUPPLY.

The Milk Question. By Prof. M. J. Rosenau. Pp. xiv+309. (London: Constable and Co.; Boston and New York: Houghton Mifflin Co., 1913.) Price 7*s.* 6*d.* net.

THE milk question is very much to the fore at the present time, and the appearance of this work is therefore opportune, and, although it embodies American views and practice, a great deal of it is applicable to our conditions. The author is well known as the present professor of hygiene at Harvard, and former director of the Hygienic Laboratory, Public Health and Marine Service, U.S.A., who has contributed much to the scientific investigation of milk and its bacteriology. From the sanitary point of view the book is sound, but, in addition, its author shows a knowledge of the subject from the producer's point of view, a side of the question which is frequently overlooked by sanitary reformers in this country. Written in simple language, it is a book for the educated public generally, and many striking cartoons and diagrams and terse sayings serve to drive home the views enunciated, *e.g.*—

"It (milk) requires scrupulous care from pasture to pail, and from pail to palate."

"The milk problem starts with the cradle, and ends with the grave. Sometimes it leads to an untimely grave."

One or two considerations may be quoted as illustrating the author's appreciation of the producer's point of view. As regards the question as to where the blame lies for an unhygienic milk supply, the author says the tendency is for the consumer to blame the producer, for the producer to blame the consumer, for the middleman to blame both of these, and for the health officer to blame all three. Really, society must blame itself; we are suffering the inevitable penalties we must pay for modern conditions of life, and of all those concerned the farmer is least to blame for the situation as it exists, and the consumer in the city should be ever mindful that he has largely brought the conditions upon himself.

While expressing the opinion that bottled milk is the ideal method of distribution, Prof. Rosenau fully recognises its dangers and difficulties—difficulties in the cleansing and handling of the bottles and in transportation, which, he points out, is expensive, bulky, the breakage is considerable, and the return freight adds to the cost. He looks forward to the time when milk will be dispensed in some form of cardboard non-returnable package.

On the mixing of milk from several cows, this the author says is desirable, as it furnishes a more uniform product, and tends to dilute infection if present; this the framers of Bills in this country might note.

On the cells present in milk, it is stated that normal milk has relatively few or no leucocytes, and, when critically examined, the majority of cells distinctly differs from leucocytes.

The author would ascribe from 5 to 7 per cent. of all human tuberculosis to infection with the bovine bacillus, but he is careful *not* to suggest that this is necessarily derived from milk, and quotes Weber's observations (made for the

German Imperial Board of Health), which seem to show that the risk of infection from tuberculous milk is surprisingly small.

Clean milk, and methods of producing and controlling it, are dealt with at some length, and some interesting details are given respecting certified milk.

A long chapter is devoted to pasteurisation of milk, and this process is strongly advocated, under proper safeguards, such as labelling with the time, temperature, and date of pasteurising, as a general method for treating the milk supply if a pure milk cannot otherwise be guaranteed.

Singularly little is said respecting infants' milk depôts. In view of the comparison made by some between the United States and this country in this respect, we should have expected more information had this method of dealing with infant mortality the importance which some would ascribe to it. Altogether the book is a valuable one, and one to read, ponder, and digest.

R. T. HEWLETT.

OUR BOOKSHELF.

Theoretische Astronomie. By Dr. W. Klinkerfues. Neubearbeitung von Dr. H. Buchholz. Dritte verbesserte und vermehrte Ausgabe. Pp. xxxviii + 1070. (Braunschweig: F. Vieweg und Sohn, 1912.) Price 50 marks.

THE claims of Klinkerfues and Buchholz are readily admitted by all acquainted with the calculation of orbits. The classical treatises of Oppolzer and Watson having run out of print, it was most fortunate that this, the practical, side of gravitational astronomy was taken up by Buchholz, who extended the original work of Klinkerfues to make it fit to take the place of the former works. The plan of dividing the subject-matter into lectures (*Vorlesungen*) is still continued, although much is unsuitable for verbal exposition. Lecture 14, for example, extends to ninety pages, and gives, besides the general theory of the earth's rotation, all the formulæ necessary for the reduction of observations.

The greater part of this edition agrees exactly with the last, but the additions are well worthy of attention. The new preface runs to twenty pages, and gives a historical treatment of recent advances in the theory of orbits. Although Gyldén's work in no way enters into the subject treated in the work, Buchholz has described at some length the claims of the great Swedish astronomer. We believe that posterity will give to Gyldén the place which is due to one who did much for the cause of dynamical astronomy as applied to real, in contrast with merely ideal, problems. The criticisms of Bauschinger and others have led to Harzer's method not being developed, but the vector method of Willard Gibbs is retained. We are glad to see that Leuschner's method has been introduced. The method is carefully explained, the formulæ are collected, and a considerable number of examples are worked out. The necessary new table is given, and Oppolzer's M- and N-tables have been reproduced.

An appendix gives the known errors in the works of Bauschinger and Oppolzer on the determination of orbits.

The greatest fault of the book is its bulk. For a work intended to assist in the numerical calculation of orbits it is almost essential that the auxiliary tables should be easily manipulated. This work could with advantage be divided into several volumes.

J. JACKSON.

New Contour Map of the Near and Middle East (The Land of the Five Seas). (London: G. W. Bacon and Co., Ltd.) Price 7*s.* 6*d.*

THIS wall-map includes the empires of Babylon, Persia, Parthia, Egypt, and Rome. It shows the routes of Alexander the Great, Pompey, and St. Paul, and illustrates classical history from the earliest times. The scheme of ten colours makes it possible to show with impressive clearness the close relation between land configuration and the spread of civilisation. The scale of the map is ninety-five miles to an inch. In the bottom left corner an inset orographical map of Palestine is provided. The size of the map as a whole—40 by 30 in.—will indicate that it is scarcely large enough for use in big classes, but it should prove of service to individual students in the higher forms of secondary schools.

The Tarn and the Lake. Thoughts on Life in the Italian Renaissance. By C. J. Holmes. Pp. xi + 48. (London: Philip Lee Warner, 1913.) Price 2*s.* 6*d.* net.

THIS essay of Mr. Holmes forms very pleasant reading; originally designed as an introduction to a few studies of Italian painting and sculpture, it overran its intended bounds and became eventually the present little volume. Entertaining analogies are drawn between certain communities of fish and certain societies of men, and though the appeal is more directly to anglers, all readers who appreciate literary expression will enjoy the essay.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Pianoforte Touch.

THE question as to whether what is known as touch is due to any peculiarity, apart from the energy, with which the hammer strikes the strings, and, consequently, with which the fingers strike the keys, would appear to be determinable by direct experiment. Personally I have always held, probably with the majority of people, that touch is dependent on such peculiarities, but the evidence seems to be decidedly against it. A note was struck one hundred times in succession so as to produce sound of as nearly as possible the same intensity; on half these occasions it was struck in a pressing, or caressing, manner; in the other cases it was struck sharply; the different kinds of blows were intermingled irregularly, and according to a list previously drawn up, and the damper was held up while the note was being struck. As each note was struck a verdict as to its quality was given by a person sitting out of view of the piano, and this verdict was compared with the character of the blow given. The observer, it should be mentioned, was not a trained musician, but was exceptionally appreciative of what is called touch.

Discarding all cases where the note had accidentally been more or less loud than the average, it was found that in 49 per cent. of the cases of uniform loudness the effect on the auditor coincided with the character of the blow given, in 51 per cent. the reverse. In another series of 100 notes the values were 51 and 49 respectively. It is evident, therefore, according to this, that different quality of touch produces no difference in the quality of the sound produced. No doubt further evidence should be obtained by a repetition of such experiments with other performers and other observers, and a further test would be obtained by having two performers alternately striking the same note, and ascertaining whether the observer could detect the difference.

Even if the independence of "touch" on the character of the stroke is fully established, there is no difficulty in explaining the apparent difference in touch of a performance with the fingers and one with a piano-player. At least seven factors may be specified as determining touch:—(1) Differences in loudness of a note (or notes) as compared with that of the preceding notes, (2) deviation from the theoretical value, according to the score, of the duration of the note as compared with that adopted for the preceding and succeeding notes (*i.e.* different degrees of *staccato* or *legato*); (3) variations in time as compared with that of the preceding notes; (4, 5, and 6) similar differences in loudness, duration, and time of one note in reference to its nominally contemporary notes; (7) the use of the loud pedal. The use of the soft pedal is so specialised that it need not be considered; it is used more for modifying a whole passage than for modifying individual notes, and it practically gives the performer the command of a second instrument; but, perhaps, an eighth factor of a general character should be included, namely the extent to which the above means of emphasising notes is made to harmonise with the rhythm and sense of the music.

Now, in the piano-player we have the means, either by moving levers or by pressure on the bellows, of altering the loudness (1) or time (3) of a note as compared with that of preceding notes, but such alterations are gross and sluggish in comparison with those possible in finger playing; the inertia of the mechanism has to be overcome, and the result depends directly or indirectly on the pressure of air in the bellows, which cannot be altered instantaneously. The least unsatisfactory operation is a retardation of the time. The duration of the note as compared with that of its neighbours (2), or of its fellow-notes (5), as well as the loudness of it as compared with its fellow-notes (4), can only be accomplished by modifications in the slots of the roll, and they are, therefore, stereotyped and always the same; this produces a very unsatisfactory result.

When hearing for the first time a well-played piece with the air strongly brought out in this way, the impression produced is decidedly favourable, but at the second hearing a sense of irritation is felt; we know exactly the degree of emphasis which is going to be placed on each note of the air, and the monotony is even more trying than where no emphasis is attempted. It is a case similar to that of a beautiful landscape which never changes; the charm of music lies largely in its imperfections, or, at least, in the varying and unexpected degree in which its beauties are brought out. An alteration in the time of contemporaneous notes (6) is, I believe, attempted on some rolls, but the effect, I should imagine, would be even less satisfactory than in the other cases. The use of the loud pedal is a potent defect in the piano-player. Needless to say, this pedal is not used in good finger playing only to produce loudness, but more generally to produce softness, and a smooth flow of sound. In a slow movement a good performer will often depress and raise the pedal for nearly every note, and the effect produced depends entirely on the correct timing of these movements with the depression of the keys; this is impossible unless the messages from the brain to the fingers and to the feet are simultaneous. This cannot be so with a piano-player, where the sound is produced by a separate mechanism; this sound (either of the particular note in question or of its predecessor) must travel to the brain, which then has to interpret it, and to send a message to the finger which controls the pedal lever; the performer is conscious of an act of thought being necessary in using the pedal of a player, whereas in finger playing its use appears as if it were instinctive. With the player it is practically only used for producing loudness.

I believe that the thud of the air on the keys is another defect in the player. When in the same room as the instrument, it seems possible to decide after hearing one bar whether the player or fingers are being used, and this is certainly so, as I have ascertained by trial, and apparently more easily so, when one is in a distant room, the reason of this being that the thud penetrates the walls more easily than the note, and hence attains more relative predominance. I have an instance of this in a striking clock, of which the note is inaudible in the next room, while the thud can be distinctly heard.

No doubt many of the defects of the piano-player will be diminished in time, especially by such devices as those of Prof. Bryan. Already one of the best piano-makers is putting on the market an instrument which is a great advance on its predecessors, the chief feature of it being a reduction in the size of the bellows, which admits of much greater control over the sound production. Still, it is a case of playing with the feet, instead of with ten independent fingers.

When the damper is allowed to act in the ordinary way, it is possible that the effect produced (touch) may be modified by the character of the blow given to the keys, for this blow results in the damper being raised, as well as in the hammer striking the strings, and these two actions may not synchronise to the same extent with blows of different character.

SPENCER PICKERING.

A Danger of so-called "Automatic Stability."

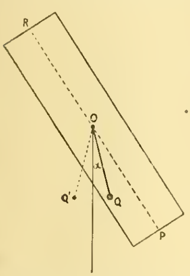
FROM time to time devices have been proposed for securing "automatic stability" in aëroplanes by means of a suspended weight or "pendulum," which operates on rudder-planes governing the motion of the machine. A similar device is also in actual use for governing the motion of torpedoes in a vertical plane, in conjunction with a further device for maintaining the torpedoes at a constant depth below the surface, or more strictly at a level where the hydrostatic pressure is constant. "Pendulum" arrangements for automatic stability of aëroplanes have frequently figured in the pages of such journals as *The Scientific American*, and it must be admitted that such devices are calculated to appeal strongly to the imagination of readers whose knowledge of dynamical principles is limited in range or *nil*.

The statement, which stands in my name, to the effect that such a device increases the number of degrees of freedom of the apparatus with an accompanying increase in the number of possible oscillations and of conditions necessary for stability is, I believe, incontrovertible. One form of dynamical instability that may result in such cases is the setting up of violent oscillations, ever increasing in amplitude, in the pendulum itself, accompanied by flapping of the control planes, in which case this particular method of control becomes worse than useless.

The remedy which naturally suggests itself, in such circumstances, is to damp down the oscillations of the pendulum by means of frictional or other resistances, and it is probable that few university graduates who have taken first-class honours in mathematics would think that such a contrivance could possibly be wrong. The following test case will show how very dangerous it is to attempt to draw conclusions from general considerations.

For the aëroplane or torpedo, we substitute a heavy, rigid body POR, free to rotate without resistance about a horizontal axis through its centre of gravity O, perpendicular to the plane of the paper, and therefore, in the absence of other causes, in neutral equilibrium, and we assume that the moment of inertia of this body is considerable.

We next imagine a light, small pendulum OQ to be fixed in bearings in the body POR, so that it can turn about the same axis, but we suppose that a frictional couple is called into play between the large body and the pendulum at these bearings. The pendulum being light, this frictional couple exerts no appreciable effect on the large body POR, but the friction is sufficient rapidly to damp out the oscillations of the pendulum itself. The effect of a rudder plane controlled by the pendulum we represent by the assumption that the pendulum operates some mechanism which impresses on the large body a couple proportional to the angle QOP, tending to make it revolve towards OQ, the object of this couple being to bring that body into a position of rest in which OP is pointing vertically downwards.



When the large body is rotating in the counterclockwise direction (as in the figure) the small pendulum assumes a position of equilibrium OQ on the right-hand side of the vertical, and inclined to the vertical at a certain angle α, the moment of its weight then just balancing the frictional couple. When the body begins to swing backwards the pendulum swings with it until both have described an angle 2α, so that the pendulum occupies the position OQ′, now making an angle α on the opposite side of the vertical. During this portion of the motion the controlling mechanism impresses on the body a constant angular acceleration, because the angle QOP remains constant. Consequently in the new position the body is rotating with a certain angular velocity set up by this acceleration. In the subsequent motion the pendulum remains at rest in the position OQ′, and the body performs a simple harmonic rotation about OQ′, but owing to its initial angular velocity it does not come to rest until its angular distance from OQ′ is greater than the angle QOP. It follows by this reasoning that the oscillations increase in amplitude, and this effect owes its existence to the frictional couple.

G. H. BRYAN.

The Structure of the Diamond.

WE have applied the new methods of investigation involving the use of X-rays to the case of the diamond, and have arrived at a result which seems of considerable interest. The structure is extremely simple. Every carbon atom has four neighbours at equal distances from it, and in directions symmetrically related to each other. The directions are perpendicular to the four cleavage or (111) planes of the diamond; parallel, therefore, to the four lines which join the centre of a given regular tetrahedron to the four corners. The elements of the whole structure are four directions and one length, the latter being, in fact, $1{\cdot}52 \times 10^{-8}$ cm. There is no acute angle in the figure. These facts supply enough information for the construction of a model which is easier to understand than a written description.

If we proceed from any atom, using only standard directions, to the next but one, the straight line joining the first to the last is a diagonal of a face of the cubical element of structure; if we move in the same way through four stages, using all four standard directions in turn, the straight line joining the first and the last is a cube edge. Starting from any atom we can return to it after six stages, using three standard directions twice each. In this way we always link together rings of six carbon atoms.

If the structure is looked at along a cleavage plane it is seen that the atoms are arranged in parallel planes containing equal numbers of atoms, but separated by distances which alternate and are in the ratio 3 : 1 (actually $1{\cdot}52 \times 10^{-8}$ cm. and $0{\cdot}51 \times 10^{-8}$ cm.). It is a consequence of this arrangement that no second order spectrum is reflected by the (111) planes, although spectra of the first, third, fourth, and fifth orders are found. It was this fact that suggested the structure described above. Several other tests, however, may be applied, and all are satisfied.

Zincblende appears to have the same structure, but the (111) planes contain alternately only zinc and only sulphur atoms. In this way the crystal acquires polarity and becomes hemihedral.

W. H. BRAGG.
W. L. BRAGG.

Leeds, July 28.

Artificial Hiss.

REPLYING to the inquiry of Lord Rayleigh (in NATURE of May 29, vol. xci., p. 319) as to the way in which an artificial hiss may be produced with a moderate pressure of air, I suggest that a current of air directed against a sharp edge of a knife held somewhat obliquely may answer his purpose.

In this connection it is interesting to note that for the formation of the hissing sound in our mouth the presence of saliva seems necessary. If I dry the tongue and the other parts which are needed for the pronunciation of the hissing "s," it is almost impossible to produce an audible "s," and the tongue—instinctively, as it were—makes an effort to gather some saliva and to wet itself.

I would therefore suggest that Lord Rayleigh wet the end of the rubber tube with which he experimented.

FRED J. HILLIG.

Kioicho 7, Kojimachi, Tokyo, July 1.

IT had occurred to me also that the moisture of the mouth might play a part in the production of a hiss, but I do not find that such drying as I can give makes an important difference.

I have to thank several correspondents for suggestions. In particular, Mr. G. Beilby sent me two pipes suitable for a 4 in. water pressure, which gave a better effect than anything I had then tried, but still, in my estimation, much short of a well-developed hiss. I doubt much whether any pure tone gives the full impression of an "s," having often experimented with bird-calls of about the right pitch. Perhaps a rapid *change* of pitch is essential. RAYLEIGH.

Prof. Armstrong and Atomic Constitution.

In the April number of the quarterly journal called *Science Progress* appears an article signed H. E. A., in which that distinguished chemist at length accepts, though not without hesitation and sustained scepticism, some of the results deduced by physicists from the phenomena of radio-activity; but he takes the opportunity of restating and reinforcing his opinion that the inert gases—helium, for instance—are not really monatomic—an opinion expressed by Prof. Armstrong soon after the discovery of argon.

To maintain this rather strained position in face of experimental facts, a considerable amount of what seems to me gratuitous hypothesis is required; and since it is desirable to come to a better understanding of this matter, I propose to criticise his attitude, in a friendly way, in the October number of the same journal. OLIVER LODGE.

Distribution of Amphidinium.

BIOLOGICAL readers of NATURE will perhaps recollect the record of the finding of the dinoflagellate, *Amphidinium operculatum* (previously unknown in Britain), on the beach at Port Erin a couple of years ago. Since then it has been present in great abundance at Port Erin on many occasions; Mr. R. D. Laurie has found it at Hoylake, near Liverpool, two of our young Liverpool zoologists (R. J. Daniel and J. E. Hamilton) now at the Belmullet Whaling Station, co. Mayo, inform me that they have noticed it on the shores of Blacksod Bay, and now I have to-day found it here in abundance, staining slightly in patches and streaks the beautiful white shell-sands of Iona.

Both the forms found at Port Erin—viz. the shorter discoid (the typical *A. operculatum*) and the larger more ovate form which I have described from Port Erin—occur here, associated with a few Naviculoid diatoms.

It seems probable that this curious dinoflagellate, known in the living state so far as I can ascertain to very few biologists, and previously recorded from only three or four far-distant localities, is really very generally distributed, and might be found by careful searching on many sandy beaches.

W. A. HERDMAN.

S.Y. *Runa*, Sound of Iona, N.B., July 20.

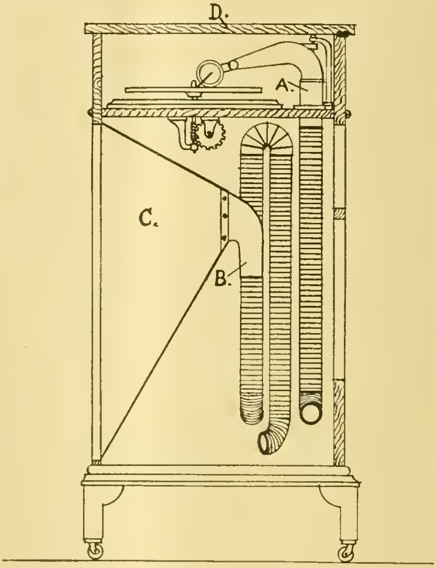
Gramophone Improvements.

I HAVE greatly improved my gramophone, at any rate for use in rooms of moderate dimensions, by applying to it both the long tube arrangement for eliminating scraping noises—described by Mr. Ernest De la Rue in NATURE of November 14, 1912—and also the "donkey's ear" form of trumpet, devised by Mr. Sidney G. Brown, which I have the latter's permission to describe.

The accompanying illustration shows an elevational section through the instrument as altered. From the sound-box, the sound passes through the usual movable arm and the socket A into one end of about 14 ft. of 2 in. flexible steel pipe, arranged in six vertical lengths, of which four are shown in the illustration; the other end of the pipe, B, being connected to the trumpet C. As in the case of Mr. De la Rue's machine, the bends in the pipe are made of zinc, and it seems that it is chiefly these bends that almost entirely eliminate the scraping noise due to the friction of the needle on the record.

The "donkey's ear" trumpet devised by Mr. Brown is shown in section at C. It is made of four flat pieces of three-ply Birch fretwork wood of about $\frac{1}{8}$ in. total thickness. It has an oblong mouth, and its special feature is that, like the ears of donkeys and many other animals, it is shaped with a top and bottom of unequal lengths so as to resonate comparatively equally to sounds of widely different pitch.

It has been found desirable to put a felt seating for the lid D to rest on, as though previous to the alteration the amount of scraping noise that came



out through the trumpet was so considerable that it made very little difference whether the lid was closed or open; with the new arrangement this scraping is eliminated to so great an extent that until the felt was inserted quite an appreciable amount of noise was found to come out round the lid.

Though the instrument is not so loud as previously, the reproduction of sounds of all descriptions seems now much more accurate than before, while the objectionable scraping noise has been virtually done away with. A. A. CAMPBELL SWINTON.

66 Victoria Street, London, S.W., July 24.

The Maximum Density of Water.

I FEAR Mr. W. B. Croft will get few to agree with him in supposing that it would make little difference in the conditions existing on the earth whether water was at its maximum density at 0° or at 4° above it (NATURE, July 17). If water was densest at 0° there would be little surface ice, as water does not change to ice at 0° unless in the presence of ice crystals or other solids. The ice-cold water would therefore, after sinking, freeze when it came in contact with the solid bottom, and we would have much anchor ice and but little on the surface. The small margin of only 4° does not seem to be quite enough entirely to prevent anchor ice; still we have reason to be thankful for these few degrees.

JOHN AITKEN.

THE UNPUBLISHED PAPERS OF J. J. LISTER.

A LARGE parcel of miscellaneous papers by J. J. Lister, and some pieces of apparatus, were left to the Royal Microscopical Society by the late Lord Lister. The papers were eventually submitted to me for examination, and this resulted in the discovery of the important paper on the limit of defining power in vision with the unassisted eye, the telescope, and the microscope now published in the society's journal.[1]

The underlying remarkable experiments were made, and a first—still existing—MS. prepared in 1831–2, shortly after Lister had published his famous paper on the improvement of the achromatic compound microscope (Phil. Trans., 1830, pp. 187–200). The manuscript was entirely rewritten, practically as now published, in 1842–3, and again revised in 1853; but although the author lived until 1863, he never published this excellent piece of work, which is interesting and instructive even now, fully eighty years after the doing of it and just fifty years after the author's death.

The original paper is now so easily accessible, and is so well worth reading, that instead of giving a detailed account of the contents I propose discussing more particularly those of Lister's results which are either of real interest even at the present time, or open to criticism as to their validity.

The most striking feature of the work—and undoubtedly so intended by the author—is its absolute homogeneity; for precisely the same objects were used in experimentally determining the limit of resolving power of the naked eye with full aperture and through circular apertures down to 0·00059 in. diameter, of telescopes of various apertures up to 4 in., and of a large number of good microscope objectives covering a wide range of angular apertures.

The objects, which are still in existence, being included among those now in the keeping of the Royal Microscopical Society, were very accurately made coarse gratings, produced by sticking paper on glass plates, cutting parallel lines through it, and removing strips at equal intervals. There was also a similarly produced chess-board pattern on glass, the separation from line to line or square to square being of the order of 1/10 in. This coarseness of the objects leads to the principal point worth discussing; for, as only 400 ft. distance was available, the objects could not be observed directly, even in the telescopic experiments, a diminished image of the actual object in a convex mirror having to be used instead.

In the microscopic observations a very greatly diminished image was employed which an auxiliary objective of higher power and wider angular aperture than that to be tested projected in the common focal plane of both. To most people this will appear as a perfectly legitimate proceeding involving only the most elementary optical assumptions and therefore not open to objection. But a crude method of carrying out this process with the microscope by observation of the small images formed by air-bubbles or fat-globules in a watery liquid has been severely criticised by Abbe for two reasons: first, because such images, when received by microscope objectives of wide aperture, must be affected to such an extent by aberrations as to render any calculation as to their size and nature utterly futile. Little can be said against this, but it does not apply to Lister, as he takes great care to state that the projecting lens was a perfectly corrected and carefully adjusted microscope objective. But Abbe raised a second objection of more serious aspect:—

"Even supposing that a perfectly corrected projection-system be used, the observation is not really a microscopical one at all; it is a quasi-telescopic observation of the actual object by an instrument giving erect images, consisting of the projecting system and the real microscope, which latter acts merely the part of an erecting eyepiece."

There is no answer to this argument *so far as it goes*. But it really misses the crucial point, the only point of interest, altogether. And if we concentrate our attention on this, the question to be answered becomes this: Does the light received by the microscope from a perfectly corrected projecting lens differ in any essential respect from that which it would receive from a real object similar in every respect to the large one actually used, but diminished in size according to its distance from, and according to the focal length of, the projecting system?

The only answer to this question seems to me to be that there is no essential difference, and that Lister's results are perfectly valid. For on the older theory, which assumes that objects may be treated as if they were self-luminous, each point in the real object will send out spherical waves towards the projecting system, which turns them into perfectly spherical waves converging towards the conjugate point of the aërial image, from which they expand again so as to form, at a little distance, perfectly spherical waves *from* the same conjugate point as a centre, precisely as if the conjugate point itself were the true origin. The complicated interference phenomena which arise close to the focal plane, in what the late Dr. Johnstone-Stoney so aptly called the region of turmoil, have no effect on the form of the waves beyond that region. And if we adopt the Abbe theory we are led to substantially the same conclusion, for by the combined effects of the principle of equal optical paths between conjugate points and of the optical sine-condition we can easily show that the diffracted waves received by the projecting system are turned into such directions as to correspond exactly in every respect to those which would be sent out by an actual object of the size and structure of the ideal image of the real object.

We may indeed say that Lister not only gained the advantage of absolute homogeneity by his procedure, but that he avoided a very grave objection which, in fact, renders open to doubt,

[1] Journ. R. Micr. Soc., 1913, pp. 27–55.

if not absolutely futile, much of the work done by amateur theorists—namely, that observations for theoretical purposes must be made on objects of a structure which is perfectly known by some independent method, as otherwise we are moving in a "vicious circle." It is clear that in the case of the higher powers of the microscope this difficulty cannot be avoided with delicately marked natural objects examined directly.

The numerical results obtained by Lister are still of great value.

For the naked eye he finds that there is practically no gain in resolving power when the pupil is opened beyond 0·095 in.; that the difference in keenness of vision of different individuals rapidly decreases when smaller and smaller apertures are placed before the eye, and that with apertures below about 0·025 in. all reasonably normal eyes have the same resolving power which corresponds to his general formula. In this section we find a remarkable instance of the accuracy of his observations; for he records the fact that—contrary to his preconceived idea—two or three lines are more easily separated than a larger number; this has in recent times been theoretically confirmed!

The telescopic section is the shortest, owing to difficulties from unsteady air and bad light. But it includes interesting measurements of the diffraction rings of the spurious star-disc. The limit of resolution arrived at is 4·33 seconds of arc divided by the diameter of the object-glass in inches.

Probably the most remarkable results are those recorded in the microscopical section, which also contains the most surprising proof of the extraordinary accuracy of Lister's observations. For these enabled him to deduce that the resolving power of microscope objectives did not increase in proportion to the angle of aperture, but to the chord of that angle—in modern language, to what Abbe, forty years later, called numerical aperture. When it is considered that the widest angle accessible to Lister was one of 80°, and that even for that the ratio of chord to angle is merely that of 10 : 13, it will be realised that this was a very creditable feat.

The limit of resolution for the microscope arrived at by Lister, when translated into modern terms, is 95,240 lines per inch for N.A. 1·00. It should, however, be stated that although there are a very few observations reaching or slightly exceeding the figures finally adopted in the paper, these are not the *mean* of all the observations. Unlike some modern microscopists, Lister understood the meaning of the word limit as a practically unsurmountable barrier which should only be closely approximated under extremely favourable conditions, and he adopted his final numbers accordingly.

In conclusion I should like once more to advise those interested in instrumental optics to read this extremely interesting paper *in extenso*.

A. E. CONRADY.

THE ANCIENT ARTISTS OF SOUTH-WESTERN EUROPE.

THE attention of readers of NATURE has been directed from time to time to the numerous and interesting archæological discoveries in the caves and rock-shelters of central and southern France and northern Spain, which are due to the energy and skill of Prof. l'Abbé H. Breuil, MM. L. Capitan, E. Cartailhac, Prof. H. Obermaier, E. Piette, and others. During the last two or three years similar investigations have been made in other parts of Spain, mainly by the indefatigable Abbé Breuil with the co-operation of Juan Cabré Aguilo, Pascual Serrano Gomez, and Gomez Moreno, and we should like to take this opportunity of congratulating the Spanish archæologists on pursuing this fascinating line of inquiry, which already has led to important results.

The epoch-making monograph "La Caverne d'Altamira," by E. Cartailhac and H. Breuil (1906), is being followed by the publication of equally sumptuous memoirs on the more important French caves. These, together with the numerous papers and smaller memoirs that have already appeared (mainly in *l'Anthropologie*), prove that central and southern France and Spain north of the Cantabrian Mountains constituted an area throughout which the later stages of Palæolithic culture were spread with remarkable uniformity. This sequence consists of the Aurignacian, Solutrian, Magdalenian and Azilian industries, with their accompanying manifestations of glyptic and pictorial art.

The earliest phases of the art of the Franco-Cantabrian area are characterised by rude statuettes of the human figure, which are followed by beautifully executed carvings of animals in the round or in relief, and by large numbers of engravings on bone, ivory, and stone. The earliest engravings are linear scrawls, and even rude but vigorous drawings of animals on clay surfaces. The walls of numerous caves were also decorated with engravings and paintings of animals, of which the following sequence has been established.

First phase: the engravings consist of broad deep incisions; many of them are unrecognisable; some are profile representations of animals with but two legs drawn; the paintings have a similar character, but the earliest efforts were simple impressions in colour of the human hand and timid attempts at linear designs and grouped dots. Second phase: the incisions are still broad and deep, but the drawings are more lifelike; the four legs are shown, and hair is often indicated; the clever brush outlines of the earlier part of this phase are replaced by monochromes, some of which are beautifully shaded. Third phase: the engravings are now in thin lines; they vary in excellence, but some are real masterpieces; the paintings are deplorable, owing to an excessive use of pigment. Fourth phase: the engravings lose their importance, and in some cases are merely employed as subsidiary to painting; the artists try to regain by the use of various colours the modelling lost in the preceding phase; at first they are timid, the animals are outlined in black and the paint laid on in masses, but they soon obtain a mastery of the technique, and produce wonderful shaded polychrome paintings of bisons, boars, and other animals in various positions. Fifth phase: there is no longer any mural engraving; nor are there paintings of animals, but merely painted bands, branched designs, dots, and so forth. With this decadence that marks the

FIG. 1.—Group of red animals on a rock at Cogul: stag surrounded by hinds; to the right an ox and elk. Behind the ox is a black head of a hind of earlier date. Length of panel, 0·75 m.

Azilian period comes the close of the Palæolithic age.

The question naturally arises, whether the simple decoration and absence of naturalistic drawings of the Azilian period are due to a degeneration of the Magdalenian art, or whether they reflect a movement from elsewhere. The evidence certainly points to the latter explanation, as the implements are also different from the Magdalenian and agree with those from pre-Neolithic sites in Italy, Sicily, Tunis, Algeria, and south Spain.

In various other parts of Spain pictographs have been found in rock-shelters and on rocks in the open; these form an eastern and a southern group. The rock-paintings in the lower valley of the Ebro at Cretas were first noted in 1903, but not studied till 1908, while those at Cogul were discovered in 1907 (Fig. 1). In every case they are in full daylight and often exposed to the weather, whereas all those previously considered are in the deep recesses of dark and usually tortuous caves. The paintings of the Dordogne include bears, lions, mammoths, rhinoceroses, horses, bisons, wild oxen and goats, deer, and reindeer. The reindeer and mammoth scarcely occur in the caves of the French Pyrenees, while in those of Cantabria the reindeer is entirely absent, and there are two elephants and one bear. Throughout the whole region representations of human beings are practically absent.

In the frescoes of eastern Spain the deer, primitive ox, and wild goat are very abundant; there are also a few wolves, one horse, one male elk, some fallow deer, and a bison. We are here in a different zoological area. With the exception of two very diagrammatic deer at Cogul (Fig. 2), all the animals are depicted with the same artistic feeling that is exhibited in the Magdalenian art of France and Cantabria; there is the same ability to seize forms and attitudes, the same certainty of execution. The number of human beings that are drawn marks a sharp contrast to the art of the north. At Cogul there was found a remarkable fresco representing a group of nine partially clothed women apparently dancing round a small nude male figure—doubtless a representation of a ceremony that may have had fecundity for its object; 300 kilometres south of Cogul, near Alpéra, two very similar women were painted in the midst of a wonderful assemblage of men and animals. The men are always nude, often they wear feather head-dresses and tasselled leglets; they are drawn in various attitudes, and the majority of them are shooting with bow and arrows at deer and other animals (Fig. 3). The investigators have satisfied themselves that the paintings belong to the Magdalenian period, and now we have indisputable evidence that at all events in the latter part of the Palæolithic age the bow was a common weapon in Spain; its presence has not yet been proved in the Franco-Cantabrian area, but we know that the spear-thrower was employed by the French Magdalenians. Two large male figures at Alpéra in a dancing attitude, wearing a feather head-dress and flourishing a bow and arrows, have doubtless a ceremonial significance, and may represent magicians.

There is nothing to show whether the above-mentioned schematic figures at Cogul were earlier

FIG. 2.—Hunting scene painted in red on the rock at Cogul: man shooting a deer; the figure to the right is a dead deer lying on its back with legs in air. Length of fresco, 0·75 m.

or later than the other naturalistic paintings, for assuredly they were not done by the same artists. The same style reappears at Alpéra, in the eastern area, where it is easy to see that it is later than the fine style.

At Batuecas, in west-central Spain, enormous panels are covered with dots, rows of lines, branched, scaliform, pectiform, and other signs, circles, and rayed figures, together with very schematic men and animals (Fig. 4), which are later than certain more naturalistic drawings. Precisely similar diagrammatic signs occur in profusion in Andalusia, and below a few of them l'Abbé Breuil has found small, poorly executed, but realistic figures of the same kind as those at Batuecas. The signs agree with those that are found superimposed on Magdalenian drawings in the Franco-Cantabrian area, so there is little doubt that they characterise the Azilian culture.

FIG. 3.—Hunting scene painted in a brownish red, older than the very diagrammatic red signs (in cross-hatching) and later than the light red hind in the centre. Scale, about ⅙.

Prof. Breuil has given in *Rev. Arch.*, xix., 1912, p. 193, a large number of sketches from central and south Spain which are evidently degraded representations of the human form.

In the same article he points out that, so far as is known, the art of the Franco-Cantabrian area developed *in situ* throughout a considerable period during which the climate, vegetation, and fauna were modified several times, while migrations of peoples, all of whom were hunters and collectors, took place in different directions. The realistic representations of animals by the Aurignacians continued through Solutrian to the end of Magdalenian times, and until the extinction of the reindeer in France and central Europe. Human figures, as we have seen, were rarely portrayed except at the beginning of this series of cultures. Then an invasion from the Italian and Iberian peninsulas brought other peoples to north-west Europe, who painted schematic and geometric forms, often very like those painted on rocks in south and west Spain.

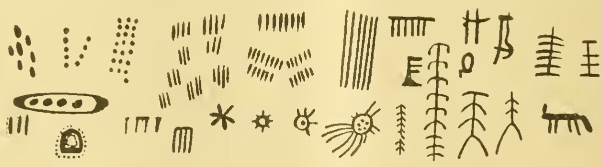


FIG. 4.—Azilian signs at Batuecas (Salamanca) which recall the coloured pebbles and petroglyphs of Andalusia.

These latter seem attributable for the most part to peoples who, while in the Palæolithic stage of evolution, did not progress through the Aurignacian-Solutrian-Magdalenian line of evolution that extends from Cantabria to Poland, but advanced in the direction of the industries termed "Capsian" by de Morgan and "Getulian" by Pallary. The eastern Spanish art may have been derived from north of the Pyrenees or influenced by it, at the same time undergoing a local development. On the other hand, Breuil notes that influences of the schematic art of the south-west were felt in the Magdalenian art of Cantabria and even of the Pyrenees, and that a cave in Ariège also shows pictorial influence from the artistic province of east and north-east Spain.

"As a result of the arrival of Neolithic man in the south of the Iberian peninsula, the Capsians flowed over the Magdalenian world, substituting their schematic art for the realistic art of the Magdalenians; borrowing from them some slightly modified industrial objects, like the harpoon, they spread not only to Gascony and Aquitaine, but to Dauphiné, Switzerland, Bavaria, and even to Scotland. On the other hand, some Capsians of Andalusia and Murcia seem to have rallied to the new state of things, since certain painted rocks represent 'idols' known only in the ancient Neolithic age in these regions, and certain Portuguese dolmens preserve a mural decoration conceived in their style. Perhaps other Capsian groups, driven from Morocco by the newcomers, migrated into central Sudan, unless the strange analogy of the paintings found there with those of Andalusia be purely fortuitous."

A. C. HADDON.

EXPERIMENTAL CANCER RESEARCH.

EXPERIMENTAL cancer research can be undertaken with two main objects in view: (1) The investigation of the origin of cancer; (2) The study of the properties and life-history of the developed tumour. In regard to the first of these objects the staff of the Imperial Cancer Research Fund has confined its attention to the question of heredity. In the present report [1] there is a summary of observations on this point which confirm the conclusions previously published. In mice with recent cancerous ancestry, 20 per cent. of all deaths were due to cancer, while in those with remote cancerous ancestry the ratio was 11·6 per cent. It will be interesting to see whether further research in this direction will reveal any relation between the types of tumour in the ancestors and their progeny, and whether there will be any appearance of the Mendelian phenomenon.

The main efforts of experimental cancer research are, however, directed towards an investigation of the properties and life-histories of spontaneous and propagated cancer. In this direction the record is one of steady progress; the scope of investigation is continually expanding, and new problems are constantly offering themselves for solution.

Perhaps the most striking phenomenon in experimental cancer research is the appearance of a sarcoma during the propagation of a carcinoma. Recent work brings out the interesting fact that the power of inducing sarcoma formation is not necessarily a permanent property of a particular carcinoma, but may be only transitory. Two tumours have been previously observed to have this property. In one of these, sarcoma formation was irregular, and was promoted by rapid repetition of transplantation. In the other, sarcoma formation occurred with remarkable regularity if the tumours were allowed to grow for about two months before transplantation, but did not occur if transplantation was effected rapidly. The recent history of these tumours has shown that the first has completely lost the power of inducing sarcoma formation. Of the second tumour four carcinomatous substrains have been kept growing. In one of these, sarcoma development has occurred earlier at each transplantation until it has occurred so early that it has been impossible to retain the carcinoma in propagation, and this strain has become purely sarcomatous. In another strain the appearance of sarcoma has become progressively later until the power of inducing sarcoma formation has been lost. In the other two strains the same process is apparently going on.

In this phenomenon of sarcoma formation there thus await consideration not only the problem, What causes the production of a sarcoma during the propagation of a carcinoma? but also the problems, Why does a tumour which at one stage of its propagation shows the power of inducing sarcoma formation subsequently lose this property? and What is the explanation of the variability in this power displayed by different strains of the same tumour? All we can say at present in answer to these problems is that the sarcoma formation is not due to any filterable virus or other material derived from the carcinoma cells, but requires the presence of living cells for its induction.

The curious variability of the properties of mouse-cancer is also shown in other directions. In some tumours the structure remains constant during propagation for several years, while others show great variability. An acinous carcinoma may become alveolar in type; a tumour originally showing keratinisation, sebaceous transformation, or glycogen formation may lose these properties temporarily or permanently. Similarly in its power of growth a tumour may show constancy or variability. From a single tumour two strains may be isolated, one of which constantly disappears after a short period of growth, while the other regularly grows progressively and gives rise to metastases. The power of growth in a particular tumour depends inversely on its power of inducing in the host resistance to its own growth.

In all these cases of variability the question arises, Does the variability reside in the tumour-cells, or in the tissues of the host? The available evidence goes to show that the variability centres in the tumour itself. When, for instance, a slow-growing tumour arises from one which grows rapidly, when the structure of a tumour changes in the course of propagation, or when a sarcoma arises during the propagation of a carcinoma, the changes must be ascribed to variations in the tumour-cells, the transplantation subsequently effecting the isolation of the different characters evolved. It is well to note that this variation is not always in one direction. The change in the tumour-cell is not always from one of lower to one of higher differentiation and *vice versâ*. Also tumours showing high differentiation are not necessarily the most constant, nor those of low differentiation the most variable.

One important point should be noticed; that is, the increasing evidence as to the identity in nature of the mouse-cancer with the human disease. Every feature of cancer in mice finds its parallel in man. Squamous-celled carcinomata in mice sometimes show the formation in them of cysts lined with typical squamous epithelium, and this property may remain constant during propagation. The same feature is frequently found in human squamous-celled carcinomata, and is repeated in the metastatic growth. Similarly sarcoma formation may take place in human carcinoma, as it does in propagated and spontaneous carcinoma in mice. Again, in man the structure of the primary tumour is often repeated with great constancy in the metastatic tumours, whereas in some cases there may be great variability, and tumours of the same structure in man may show great differences in the power of growth, one

[1] Eleventh Annual Report of the Imperial Cancer Research Fund. Presented July 24.

confining its growth locally, and the other early giving rise to metastases. In these respects, as in many others, the similarity in nature between mouse-cancer and cancer in man is placed on a firm basis, and the importance of experimental cancer research in relation to human cancer established.

Experimental research continues to throw discredit on the hypothesis that cancer is caused by a specific parasite.

NOTES.

It is announced that the Admiralty has accepted a tender for the construction of a large laboratory, which is to be built on the high land at Crombie and used for purposes of chemical research in connection with the ordnance works there.

Prof. W. A. Bone, F.R.S., has been awarded the Howard N. Potts gold medal for distinguished work in science or the mechanic arts by the Franklin Institute of Philadelphia, in recognition of his work upon surface combustion. Prof. Bone lectured before the institute upon this subject in October, 1911.

The King decorated the members of the British Antarctic Expedition on July 26 with the Antarctic medal and clasp. The medals and clasps awarded to those who lost their lives were presented by the King to the widows, and in other cases to the mothers. Chief Stoker W. Lashley, R.N., and Petty Officer T. Crean, R.N., were decorated also with the Albert Medal of the Second Class for gallant conduct in connection with the heroic saving of the life of Commander Evans, with the details of which readers of Nature are already familiar.

A correspondent of *The Birkenhead News* directs attention to the submerged forest at Leasowe, lying north-west of that city. Numerous relics, including coins, have from time to time been discovered, and it has been suggested that these are remains of an ancient port now submerged. It is much to be desired that this important archæological site should be thoroughly examined, and the suggestion that a committee of local geologists and archæologists should be formed for the purpose will meet with general approval. The local archæological and scientific societies might with advantage cooperate in the proposed inquiry.

A demand for a Royal Commission on the subject of venereal disease has been issued by the leaders of the medical profession. It is pointed out that the State has compelled local authorities to provide asylums for the insane, it has insisted on the notification of many infectious diseases, it has undertaken the inspection of school children, it has introduced an elaborate system to ensure the purity of food, and is building up a vast system of public health legislation. Yet the subject of venereal disease has been left severely alone. In London alone the disease claims 40,000 new victims every year, innocent members of the public are sometimes infected, it is transmissible from the parent to the offspring, and the effects of the disease are dire and widespread.

A committee, including the names of Sir H. Read, Profs. Haverfield, Ridgeway, and Dr. M. R. James, provost of King's College, Cambridge, has issued an appeal for funds to be devoted to the excavation of the Romano-British city of Wroxeter, which stands beside the Severn, five miles east of Shrewsbury. In its first phase it was a legionary post intended to watch the Welsh hills; but on the removal of the Roman troops to Chester there sprang up on the site a Romano-British town, which flourished for some three centuries, and became the capital of the Canton of the Cornovii. The city was laid out like Caerwent and Silchester, in Roman fashion, with a forum and baths, and streets crossing at right angles; but the area within its walls was more spacious than Silchester and Caerwent together. At the close of the Roman period it was destroyed by barbarian invaders, and since then has remained practically undisturbed. The excavation promises to throw much light on the later Roman period. The work will be carried on by an experienced archæologist, Mr. J. P. Bushe-Fox, with the aid of Oxford and Cambridge scholars. The scheme may be confidently recommended to the liberality of English antiquaries.

The Secretary of State for the Colonies has nominated a Committee to report:—(1) Upon the present knowledge available on the questions of the parts played by wild animals and tsetse-flies in Africa in the maintenance and spread of trypanosome infections of man and stock; (2) whether it is necessary and feasible to carry out an experiment of game destruction in a localised area in order to gain further knowledge on these questions, and, if so, to decide the locality, probable cost, and other details of such an experiment, and to provide a scheme for its conduct; (3) whether it is advisable to attempt the extermination of wild animals, either generally or locally, with the view of checking the trypanosome diseases of man and stock; (4) whether any other measures should be taken in order to obtain means of controlling these diseases. The Committee is constituted as follows:—Lord Desart (chairman), Mr. E. E. Austen, Dr. A. G. Bagshawe, Dr. Andrew Balfour, Sir John R. Bradford, F.R.S., Mr. E. North Buxton, Dr. W. A. Chapple, M.P., Sir Mackenzie D. Chalmers, Lieut.-Col. Sir W. B. Leishman, F.R.S., Sir Edmund G. Loder, Dr. C. J. Martin, F.R.S., Mr. J. Duncan Miller, M.P., Dr. P. Chalmers Mitchell, F.R.S., Prof. R. Newstead, F.R.S., Mr. H. J. Read, the Hon. L. Walter Rothschild, F.R.S., and Sir Stewart Stockman. Mr. A. C. C. Parkinson, of the Colonial Office, will act as secretary.

In the House of Commons on July 24 Mr. Runciman was able to give a very satisfactory account of the work of the Board of Agriculture during the past session. Energetic steps have been taken to stamp out animal disease, and the result is that the country is now freer from disease than any other in Europe. For a time last year there were outbreaks, and the export of pedigree live-stock ceased, but the foreign ports are now open to us again, and the result has been an unprecedented export during June, the total value of the animals sold being nearly 62,000*l.*, against 28,000*l*., the highest previously reached. Arrangements have been made for research on agricultural subjects to be carried on at a number of centres, including Rothamsted, Manchester, Birmingham, Oxford, Cambridge, the Royal Veterinary College, Leeds, Wye, Bristol, and Kew, and grants amounting to 20,000*l*. a year have been made for the purpose. In addition, 3900*l*. has been given for special investigations lying outside the scope of the programme of the special institutes. All these investigations have reference to the great fundamental problems lying at the root of the agricultural and horticultural work of the country; the work is wholly scientific. In order to bring the scientific results into the region of practical farming a number of advisers have been set up whose function it is to advise farmers or county organisers in the light of the results of the scientific knowledge that is gained. A grant of 9000*l*. per annum has been made towards the salaries of these advisers.

Now that we are at the end of the second month of summer some anxiety is being felt as to the general character of the weather to be experienced during August. June was a fair month with a generally deficient rainfall, but the conditions were mostly seasonable. July has had many shortcomings. During the early part of the month the weather was very unsettled, and the rainfall in the first three weeks was equal to the average for the whole of July except in parts of the Midlands and in the south-west of England. The special feature of the weather has been the persistent absence of bright sunshine and the consequent low day temperatures. At Greenwich there were only eight days to July 28 with a temperature of 70° or above, and there was only one day in the four weeks with the maximum day temperature above the average, the highest reading during the period being 76°. In July, 1910, the maximum temperature for the month was 76°, and in 1888 July had no higher reading than 74°. According to the average of the past seventy years July has twenty-two days with a temperature of 70° or above. The aggregate sunshine at Greenwich to July 27 is sixty-six hours, and the least sunshine for July previously since sunshine records were established, rather more than thirty years ago, is ninety-six hours in 1888, the next lowest record in July being 113 hours in 1910. July this year bids fair to be the least sunny July on record. There were only four days to July 27 with more than five hours' sunshine, whilst in 1911 July had twenty days with more than ten hours' sunshine, and the total duration for the month was 335 hours at Greenwich.

The Institute of Metals will hold its first foreign meeting on August 28 and 29 at Ghent. Prof. A. K. Huntington will preside. The congress will commence with an official welcome of the members on behalf of the University and the municipality of Ghent. A number of important scientific papers will be read and discussed. The second report to the corrosion committee by Dr. G. D. Bengough and Mr. R. Jones will be presented. The report indicates not only the causes of the corrosion of condenser tubes, but how such corrosion may be eliminated. Among the papers arranged for the meeting the following may be mentioned:—Mr. H. Garland, "Metallographical Researches on Egyptian Metal Antiquities"; Dr. W. M. Guertler (Berlin), "The Specific Volume and Constitution of Alloys"; Prof. S. L. Hoyt (University of Minneapolis), "Copper Rich Alloys"; Dr. T. K. Rose, "The Annealing of Gold"; Dr. W. Rosenhain, F.R.S., and Mr. D. Ewen, "The Intercrystalline Cohesion of Metals—Second Paper"; Mr. J. H. Chamberlain, "A Further Study of Volume Changes in Alloys"; Dr. C. H. Desch and Mr. S. Whyte, "The Micro-Chemistry of Corrosion: I., Some Copper-Zinc Alloys"; Mr. F. Johnson, "A Method of Improving the Quality of Arsenical Copper"; Prof. A. A. Read, "The Influence of Phosphorus on Some Copper-Aluminium Alloys"; and Mr. T. West, "The Determination of Oxygen in Copper and Brass." Visits will be paid to factories of importance, and numerous social functions have been arranged. Those who desire to attend the meeting should communicate with the secretary of the Institute of Metals, Mr. G. Shaw Scott, Caxton House, Westminster, S.W.

The Brighton meeting of the British Medical Association was held on July 22–26, the scientific business being conducted in sixteen sections. Among these the majority was of purely technical interest, all important problems of medical practice in its various branches having been ventilated. The section of State medicine dealt with questions regarding the Insurance Act, the importation of disease into seaports, school hygiene, and popular education in hygiene. The section of medical sociology held discussions on eugenics (Dr. E. Schuster, Dr. J. Scott, and many others), on hospitals in relation to State, public, and medical profession (Prof. B. Moore, Mr. C. F. Masterman, M.P., and various authorities, including foreign guests). Questions of general scientific interest were raised and discussed in the sections of medicine (the internal secretion in disease, by Prof. G. R. Murray), the section of electro-therapeutics (on secondary X-ray radiations in medicine, by Prof. C. G. Barkla, F.R.S.), the section of bacteriology and pathology (general pathological, experimental, bacteriological, and clinical aspects of anaphylaxis, by Profs. W. G. Dixon and G. Sims Woodhead, and Drs. Thiele, Embleton, G. W. Goodall, and H. H. Dale), the section of neurology and psychological medicine (discussion on sleep and sleeplessness, by Sir George Savage and others), and the section of tropical medicine (discussion on filariasis, by Dr. G. Low and others). We hope next week to give a descriptive article dealing in more detail with some of these discussions of general importance. The Brighton meeting was very largely attended, and was a great success in spite of the International Congress of Medicine to be held in London next week.

On account of the deadlock reached by the Committee of the House of Commons considering the Dogs (Protection) Bill, referred to last week (p. 536), it was decided at the meeting of the Committee on July 23 not to proceed with the Bill. The question of the exclusion of dogs as subjects of all experiments in this country—not only experiments under anæsthetics, but all inoculations—has given rise to an interesting correspondence in *The Times*. Mr. John Galsworthy urged that the affectionate relationship existing between the dog and man gave dogs claims to consideration over those possessed by other animals. But, as Mr. Stephen Paget pointed out, 30,000 dogs are put to death annually at the Battersea Home for Lost Dogs, whereas the total number used for experiments of all kinds in Great Britain and Ireland is only 500. Nothing can be learned, nothing can be gained, by the killing of these 30,000 dogs; and they suffer neither more nor less than dogs anæsthetised for an experiment and killed under the anæsthetic. The physiologist is so often pictured as a man who has no tender or sentimental feelings that a letter from Sir E. A. Schäfer, published in *The Times* of July 26, is particularly appropriate to the discussion. Sir E. A. Schäfer is not prepared to let Mr. Galsworthy have it all his own way in the matter of ethics and sentiment. He says:—"I also love my dog even more, I confess, than many of my own kind. If the question arose of sacrificing my dog to save my own life I might hesitate. But if it were a question of choosing between the life of my dog and that of my wife, or child, or friend; nay, even between the life of any man, woman, or child—were it the meanest beggar in the street—and that of my dog, I should not hesitate to sacrifice the dog. This I would do—and I believe Mr. Galsworthy also would do the same—to save even a single human life. And when I consider that the employment of a few uncared-for animals, which would otherwise have been uselessly sacrificed for the mere sake of getting rid of them, has been the means of saving the lives and mitigating the sufferings of many thousands of our fellow-beings, it seems to me to be beyond a doubt that both ethics and sentiment are on the side of science."

The *Scientific American* for June 14 contains an illustrated article by Dr. Bolduan entitled "Bacteriology and Your Health," in which antitoxins and other curative serums, vaccine treatment, and bacteriological methods for the diagnosis of disease conditions are dealt with in a popular manner.

To Vol. xxxv., No. 2, of Notes from the Leyden Museum Mr. R. Van Eecke communicates an article, illustrated by four plates, on variation in the beautiful "long-tailed" Indo-Malay butterfly, *Actias maenas*, of the family Saturniidæ. Four varieties, or races, are indicated, which exhibit a complete transition in the matter of colouring from dark-brown to greenish-yellow, the females of one race being more advanced in this respect than the males. In Java the females, which differ markedly from the males, are more numerous than the latter, whereas in Celebes the reverse of this condition obtains.

In connection with experiments to find parasites capable of successfully combating the spread of the gipsy moth, the Entomological Bureau of the U.S. Department of Agriculture has issued a pamphlet, by Mr. P. H. Timberlake, on the life-history of *Limnerium validum*, an hymenopterous parasite normally attacking the fall web-worm (*Hyphantria cunea*). This parasite will attack caterpillars of the brown-tail and gipsy moths, as well as the tent-caterpillar, but will only undergo its full transformation, and then but seldom, in the last. It is, therefore, a failure in the matter of checking the gipsy moth.

From the Imperial Department of Agriculture for the West Indies we have received a copy of a pamphlet on the insect pests of the Lesser Antilles, by Mr. H. A. Ballon. The work, which is well illustrated, describes in popular language the chief species of insects, mites, and ticks injurious to plants and animals. It is interesting to note that, with the great increase of cotton-growing which has taken place of late years in the West Indies, "insects which were not previously recognised as pests, and in some cases even were not known to science, have assumed an important position as serious pests."

In a report on calf-feeding experiments (North of Scotland College of Agriculture, Bulletin 17), Prof. Hendrick discusses the use of separated milk and oils as substitutes for whole milk. The data obtained from three series of experiments show that separated milk with either cod liver oil or cottonseed oil may be substituted for whole milk with good results. The average cost per pound of increase was found to be 1·83, 1·85, and 4·77 pence respectively up to the time of weaning, and both in regard to health and quality of carcase at the age of two years, the different sets of animals were indistinguishable. Although the stock which received whole milk were slightly heavier than those fed on substitutes, this difference was not great, and would be more than counterbalanced by the reduced cost of rearing.

In the current number of *Bedrock*, Prof. Punnett replies to Prof. Poulton's article on mimicry, mutation, and Mendelism, which appeared in the April number of that publication. The main point of difference between the two writers is stated by the former to be concerned with "the conception of the function of natural selection with regard to these [mimetic] resemblances." "Both of us," he says, "are agreed as to the reality of natural selection," but while Prof. Poulton believes in the establishment of mimetic resemblance by the accumulation of small variations, Prof. Punnett holds that the mimicking form has in all cases suddenly arisen as a definite "mutation." This mimetic form, he allows in theory though apparently not in concrete instances, may when once produced be "conserved" by natural selection. To Prof. Poulton's argument from the existence of transitional forms, as in the females of *Papilio dardanus*, Prof. Punnett replies that apparently continuous transitional series may occur in cases of strict Mendelian inheritance.

The Buenos Aires *Handels-Zeitung* (No. 1297) of May 3 discusses the recent discoveries of petroleum in the northern districts of Argentina, and reports the presence there of oil-bearing horizons for a distance north and south of 300 kilometres, and beside a series of moderately inclined anticlinals. This discovery is the more valuable as analyses show that the petroleum is rich in light illuminating oils, whereas that previously found in the Argentine Patagonia is rich in heavy oils. The article discusses the geological relations of the oil-fields; it points out that those in Patagonia are connected with great transcontinental fracture lines. The northern oil-fields are connected with the middle part of the South American Pacific coast, which is dominated by the great subsidence that causes the sudden change in the course of the coast near Arica. The author of the article connects this subsidence to the antipodal disturbance of the western coast of the Pacific on the Gulf of Tongking.

Though it had long been known that sudden displacements take place during strong earthquakes, the first case in which such displacements were established by geodetic measurements was that of the Sumatra earthquake of May 17, 1892. The movements of the crust were then entirely horizontal. Though no trace of any fault is visible at the surface, Prof. H. F. Reid shows (Bulletin of the Seis. Soc. of America, vol. iii., pp. 72–9) that the measured displacements imply the existence of a fault trending N.N.W. and S.S.E., and that the crust on the west side was shifted towards the north, and that on the east side towards the south. The total relative slip of the two walls of the fault amounted to 3½ or 4 metres, or about the same as that of the San Andreas fault during the Californian earthquake of 1906. As in that earthquake, also, the displacement diminished rapidly as the distance from the fault increased. Judging from the great displacements at the limits of the measured area (about 55 km. apart), Prof. Reid estimates that the ruptured part of the fault may have been from 150 to 200 km. in length.

In *Symons's Meteorological Magazine* for July Dr. Mill refers to the message recently received from Dr. Mawson at the winter camp of the Australian Antarctic Expedition and to the "interesting and remarkable fact" that daily meteorological reports are being received in Melbourne from Commonwealth Bay and from Macquarie Island. He remarks:—"No more striking advance in the study of world meteorology has ever been made than this inclusion of the Antarctic regions within the system of daily meteorological weather reports; and meteorologists must pay a tribute of gratitude to Dr. Mawson for his triumphant realisation of what, a very short time ago, would have been held to be a fantastic dream."

A pamphlet on the "Démonstration du théorème de Fermat," by Prof. E. Fabry (Paris: A. Hermann et Fils, price 1.50 francs), does not contain what its title seems to indicate. Assuming that all the details of the analysis are correct, the net conclusion is that if $x^p+y^p+z^p=0$, with p an odd prime, has an integral solution for which x, y, z, have no common factor, one of these integers must be divisible by p^2. But although this result is not much in itself, M. Fabry's tract deserves study, and may suggest some new way of attacking this famous problem. Another recent attempt by M. de Bouffall is of no value at all, as the author assumes that two equations are identical, when all that he has proved is that they have a common root.

The June number of the Proceedings of the American Academy of Arts and Sciences contains a contribution from Prof. B. Osgood Peirce, of the Jefferson Physical Laboratory of Harvard, on the maximum value of the magnetisation of iron. The recent measurements of Sir R. Hadfield and Prof. Hopkinson, by what is known as the "isthmus method," gave 1680 as the maximum. By building a large solenoid capable of giving a magnetic field of 5000 units, Prof. Peirce has been able to obviate the uncertainties which attach to the determinations of the magnetising field in the isthmus method, and has arrived at results for twenty-five examples of commercial iron which vary from 1735 for American ingot iron to 1533 for a sample of drill-rod iron. Curves are given for a number of these materials which all show how closely the reciprocal of the magnetic susceptibility of any specimen is a linear function of the magnetising field for fields above about 50 units.

Part 6 of each of the two sections—Physics and Electrical Engineering—of Science Abstracts has reached us. Each part extends to sixty-three pages, and the average length of an abstract in the Physics Section is one-third, and in the Electrical Engineering Section one-half, of a page. The engineering abstracts are in many cases accompanied by figures which are not invariably so clear as they might be. The greater length of these abstracts seems to be due to the descriptive details of apparatus and machinery on which the interest of the articles abstracted in many cases depends. So far as the dates of the articles abstracted are concerned, a glance through the two sections shows that the great bulk of them are of February, March, and April, so that the periodical is reasonably up to date. The Institution of Electrical Engineers and the Physical Society of London have earned the thanks of all workers in these two fields for their enterprise in maintaining so useful a publication.

The July number of *Science Progress* (No. 29) marks the commencement of a new volume, and a change of editorship. Sir Ronald Ross will in future guide the destinies of this well-known journal. The present number contains several articles of a wide general interest, of which the following may be named:—Enzymes as synthetic agents, by Prof. J. H. Priestley; the seats of the soul in history, by Dr. D. Fraser Harris; and scientific national defence, by Colonel Charles Ross. Drs. M. S. Pembery and O. A. Craggs cross swords on the vexed question of woman's place in nature, and Prof. H. E. Armstrong destructively criticises recent experimental work on the perennially interesting subject of the corrosion or rusting of iron, which, it is maintained, cannot possibly be brought about by the action of pure water and pure oxygen only.

In *The Biochemical Journal* (vol. vii., p. 268) Mr. E. Ashley Cooper describes the isolation from animal tissues, such as horseflesh, or ox-heart, of a substance which rapidly cures polyneuritis in birds induced by a diet of polished rice; it can be precipitated from the fats and lipoids present in an alcoholic extract of the tissue by means of ether, and, thus obtained, is extremely active. Ordinary quinine and cinchonine exert a temporary curative action upon birds affected with polyneuritis, but as this action is destroyed by heating the alkaloids at 125°, it is probable that the curative properties are due to the presence of traces of an anti-neuritic substance derived from the cinchona-bark, which is destroyed by this treatment. The same number of *The Biochemical Journal* also contains an account by Dr. R. H. A. Plimmer of a very useful method for quantitatively separating tyrosine from cystine by means of absolute alcohol saturated with hydrogen chloride, which converts the former into its ester, whilst the cystine does not undergo esterification.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR AUGUST:—

August 1. 1h. 44m. Neptune in conjunction with the Moon (Neptune 4° 59′ S.).

4. 0h. 0m. Mercury in inferior conjunction with the Sun.

12. 16h. 29m. Jupiter in conjunction with the Moon (Jupiter 4° 52′ N.).

14. 18h. 9m. Uranus in conjunction with the Moon (Uranus 3° 28′ N.).

22. 1h. 0m. Mercury at greatest elongation west of the Sun (18° 25′).

24. 5h. 23m. Mars in conjunction with Saturn (Mars 1° 9′ N.).

25. 18h. 54m. Saturn in conjunction with the Moon (Saturn 6° 53′ S.).

,, 20h. 29m. Mars in conjunction with the Moon (Mars 5° 43′ S.).

28. 11h. 43m. Venus in conjunction with the Moon (Venus 5° 25′ S.).

,, 13h. 38m. Neptune in conjunction with the Moon (Neptune 5° 0′ S.).

29. 12h. 38m. Venus in conjunction with Neptune (Venus 0° 18′ S.).

31. 8h. 52m. Sun eclipsed, invisible at Greenwich.

NOVA GEMINORUM No. 2.—Among recent references to Nova Geminorum No. 2 may be mentioned a communication by Herr C. Wirtz (*Astronomische Nachrichten*, No. 4667, p. 219), who gives the values derived from his observations of its magnitude. The observations extended from March 14 to May 12 of last year, from the time when the star was about 3·5 mag. to that when it had diminished to about 7·0 mag.

Another communication in the same number of the *Astronomische Nachrichten*, by Mr. F. P. Leavenworth, gives the position of the nova from photographs taken at the University of Minnesota, the arithmetical mean of eleven observatory positions being given as—

R.A. 6h. 49m. 11·793s. Decl. +32° 15′ 5·65″.

Another excellent series of magnitude observations of this nova is one which appears in the *Memorie della Società degli Spettroscopisti Italiani* (disp. 6, vol. ii., ser. 2, p. 105), by Dr. E. Guerrieri, at the Royal Astronomical Observatory at Capodimonte. These observations cover the period March 28, 1912, to April 29, 1913, and are accompanied by a chart. The curve shows the curious fluctuations which the light of the nova was undergoing during its gradual diminution in brilliancy.

VARIATION OF LATITUDE.—No. 4665 of the *Astronomische Nachrichten*, p. 161, contains the provisional results of the International Latitude Service of the north parallel for the period 1912·0 to 1913·0, communicated by Prof. Th. Albrecht. The author states that the method for the determination of the path of the pole is the same as that employed in his previous publications, and he gives here the mean values of the latitude of the six stations according to group on which his values are based. In one table he shows the values of the variation in latitude, and in another the values of an expression from which the variations in azimuth and longitude can be computed for every 30° of longitude from 1912·0 to 1913·0. The paper is accompanied by a chart of the now well-known form showing the polar track from 1906·0 to 1913·0. During these years the amplitude is small at first and then increases up to 1911, afterwards decreasing rapidly up to the last-mentioned year.

THE INTENSITY DISTRIBUTION OF INDIVIDUAL LINES IN STELLAR SPECTRA.—Those familiar with the lines in the spectra of new stars know that at some stages of development the lines, such as those of hydrogen, have a complicated structure, the intensity distribution being very far from uniform. Herr K. F. Bottlinger has recently taken up the study of the question of the intensity distribution of lines in many of the type stars, and communicates his results to the *Astronomische Nachrichten*, No. 4662, p. 117. The spectra were secured at the Astrophysical Observatory at Potsdam, and measured with a Hartmann's microphotometer. The investigation chiefly consisted in the study of Hγ and a few other lines in the spectra of the following stars:—α Can. maj., α Cygni, η Leonis, ζ Orionis, δ Orionis, and γ Cassiopeiæ. The paper is accompanied by a series of curves showing the form of the distribution, and brings out the fact that a systematic study on a more extensive scale might lead to important conclusions.

RECENT WORK OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN.

THE memoirs here referred to bear witness to the publishing activity of the Geological Survey during 1912 and the present year. In explanation of Sheet 299, H. J. O. White describes the country around Winchester and Stockbridge (1*s.* 6*d.*), where the broad stretch of chalk is cut by the valley of the Test. Though Crawley stands out isolated on its dome, few of our Upper Cretaceous areas show more clearly the dependence of the villages on permanent streams. It is interesting to notice that the pre-Eocene denudation of the Chalk has not entirely removed the zone of *Belemnitella mucronata* (p. 40). On the accompanying map, the unusual feature of knolls of calcareous tufa, some 5 or 6 ft. thick, is represented in the valleys of the Itchen and the Test.

The description of Devon and Cornwall is continued in three memoirs. Numerous authors are associated in "The Geology of Dartmoor" (2*s.* 3*d.*), accompanied by Sheet 338 of the one-inch map. The great mass of granite, penetrating Carboniferous strata, occupies almost all the area. Its upper surface probably lay at no time much above the present undulating surface of the moor. The Culm-Measure rocks on its margins are regarded as representing the Millstone Grit, and perhaps the higher zones of the Avonian Series. Chapter vii. directs attention to the probability that the valleys of the small streams, with a general north-westerly and south-easterly trend, are controlled by earth-fractures. The rapid deepening of the valleys during the Pliocene uplift is illustrated (p. 70) by the case of the Dart, which lowered its floor below the general platform of the country by 700 ft. The freshness of the rock on such valley-sides is in marked contrast with the depth of decomposed rock found (p. 27) across the moor. So well-written a memoir on a district visited by thousands of tourists would gain much in popularity if it were illustrated by views of scenery. Wistman's Wood (p. 60) in its desolate surroundings is a geographical feature in itself. Such appeals to the general taxpayer seem, however, to be largely the privilege of the Scottish branch of the Survey, and, as we have remarked on previous occasions, England, with all its rich associations, still awaits adequate illustration.

A considerable step, however, is made in this direction in W. A. E. Ussher's memoir on Ivybridge and Modbury (3*s*.), in explanation of Sheet 349, and by J. S. Flett and J. B. Hill in dealing with Sheet 359, the Lizard and Meneage area. In the former, we see the romantic crag of the Dewerstone, and in the latter the purple rocks of Kynance Cove and the folded schists on Lizard Head. The Lizard memoir (5*s*.) naturally has immense petrographic interest. New analyses are given of rocks that serve as types to English students, and the changes are traced from massive intrusive bodies to foliated schists (p. 97, &c.). The Kennack Gneisses (p. 129) afford a clear example of the penetration of a dolerite by a granitic magma, the gneissic structure being due (p. 140) to "injection foliation." Sedimentary schists are also present in the south and in the north-east of the area (pp. 34 and 167), and in the latter district, near Manaccan, they appear to belong to the Ordovician kiilas series. At Lizard Head, however, they strike north-north-west, and this is taken as strong evidence of their pre-Cambrian age. To mention quite another feature among the many described in this important memoir, on Crousa Down a gravel of blocks of vein-quartz resting on gabbro is regarded (p. 231) as probably a marine deposit of Pliocene age. It is now 364 ft. above the sea. The map (1*s*. 6*d*.), covering the country from Constantine to the Lizard, will surely accompany all future scientific visitors.

W. Gibson, in a special memoir (1913, price 1*s*. 6*d*.), describes the concealed coalfield of Yorkshire and Nottinghamshire, with a map showing by contours the depth of the Coal-Measure surface below the Triassic and Permian covering. North-east of Leeds 5000 ft. of Upper Carboniferous strata were removed by denudation before first Permian beds were laid down (p. 27).

FIG. 1.—Fluvio-glacial erraces, Glen Glass, eastern Ross-shire. Terminal moraine beyond. (Reproduced by permission of the Controller of H.M. Stationery Office.)

The Scottish branch deals in Memoir 93 (4*s*.) with a moorland district, where Ben Wyvis rises as a flat-topped relic of an old plateau of metamorphic rocks. The maps of the Scottish Survey (2*s*. 6*d*. each) cover individually a much larger area than those of England, and the work on Sheet 93 must have often seemed monotonous. The glacial and other superficial deposits are shown by stippling over the colour-printing used for "solid" rocks, and we no longer have the anomaly of peat and alluvium represented in colour and boulder-clay and glacial gravel omitted altogether. Fresh-water alluvia, however, still receive a separate colour. The contributions by J. S. Flett contain, as usual, much original matter. A riebeckitegneiss is described (p. 91) from Carn Chuinneag, containing ægirine and albite, and albite-gneisses occur near it, with streaks of magnetite and cassiterite. Scyelite, the remarkable biotite-hornblende-peridotite, occurs at Carn Cas nan Gabhar, two and a half miles north of the head of Loch Morie. Its exposures are almost too small to appear upon the map. Both the foliations in the great mass of igneous "augen gneiss" (why not "eye-gneiss"?) of Carn Chuinneag are attributed to pressure-metamorphism (p. 55).

In glacial times the ice moved from west to east across this area, Ben Wyvis forming an obstacle that was not completely overtopped. Ice, however, descended from it in the general easterly direction. The fluvio-glacial terraces of Glen Glass, east of the mountain, are finely illustrated in plate viii. (Fig. 1).

G. Barrow and E. H. Cunningham Craig, in Memoir 65 (2*s*. 6*d*.), describe a varied district centring in the granite mass of Balmoral Forest. The accompanying map, with its bands of quartzite and amphibole-schists folded with the Caledonian trend, shows clearly how the main granites are of later date than the earth-movements that made the Highlands. There remains some difference of opinion as to the extent to which these granites are responsible for the development of the contact-silicates present in the adjacent schists, and also (p. 26) as to the succession in the schists themselves. The remarkable boulder-bed, representing so continuous a horizon of erosion, is accepted by both authors as being near the summit of the series.

The same authors, with L. W. Hinxman, have explored the adjacent region of Upper Strathspey and the Forest of Atholl (Memoir and Sheet 64, 2*s*. and 2*s*. 6*d*. respectively). The huge granite domes of the Cairngorm Mountains lie in the north-east of the map, and the central high-road from the Grampians descends through Kingussie on the north-west. Glen Tilt, memorable for the researches of Hutton, Playfair, and Macculloch, between 1785 and 1816, on the contact of granite and limestone, occupies the south-east corner. Here, then, is a country full of inspiration for the geologist. The phenomena of river-capture are naturally interesting on the Grampian watershed; the case of the Feshie (p. 7) is notable, where it draws off the head-waters of the eastward-running Geldie Burn. On the map it appears that a preliminary capture was made of the Eidart, descending from the Cairngorm range, and that the increased flow enabled the stream to reverse the drainage at the east end of Srôn na Ban-righ. Is it, however, quite right to suggest, as is done in the memoir, that the upper part of the Feshie, at 1800 ft. above the sea, has "practically reached the base-level of erosion"?

The glacial features, including the formation of hanging valleys and dry gaps, are described in chapter ix.

In conclusion, we note that a new geological language is developing in the north. Are we to accent "calc-flintas," "hornfelses," and "kamiform"? After all, we have absorbed "taluses" and "volcanoes."

G. A. J. C.

ORNITHOLOGICAL NOTES.

A PAPER on the Plumage Bill in relation to the British Empire was read by Mr. James Buckland at a meeting of the Royal Colonial Institute on June 13. This Bill proposes to forbid the sale, hire, or exchange of the plumage or skin of any species of wild bird inhabiting, during the whole or part of the year, any region of the British Empire or Protectorates, outside the United Kingdom. Ostriches, game-birds, domestic pigeons and poultry, are excepted from the operation of the Bill, as well as skins for museums. The effect of the measure would be, by prohibiting importation, to cut off a large proportion of the plumage supplies that now reach the London market. Mr. Buckland argues that the protection of wild birds throughout the British Empire would be of immense value to agriculture and forestry, in tending to keep down injurious insects, and that the wealth thus gained would enormously overbalance the loss necessarily sustained by the comparatively small number of merchants interested in the feather trade.

The proceedings at the annual meeting of the Royal Society for the Protection of Birds, presided over by Earl Curzon of Kedleston, covered practically all the subjects and objects in which the society interests itself. Foremost among these was the plume trade carried on in order that women may decorate their hats with the plumage of the most beautiful birds in the world. Despite what has been done in some countries beyond the seas to stop this trade, it seems to flourish here exceedingly—humming-birds and birds of paradise being sold by the tens of thousands —and we seem as yet far off getting the only law which will stop the destruction, viz. a law to prohibit the wearing by women of feathers of this description. Another important subject which came before the meeting was the protection of migrating birds from the dangers they incur at lighthouses through being attracted by the brilliant lights, and flying round until they become exhausted and fall to the ground, the gallery, or the sea. To prevent this it is proposed to fit up round the lights an apparatus, newly invented, on which the birds can perch and rest. This has been tried with good result on the Frisian coast. Funds for this special purpose are required by the society, and a considerable sum has been raised. Other subjects treated of by the speakers included sanctuaries for birds, nesting boxes, reserves for wild birds, the pole-trap in Norway, and the watchers' fund, which enabled the society to see that protective legislation was carried out. The society has more than twenty watchers spread over the country from Shetland to Cornwall. This society issues quarterly its very interesting publication, called *Bird Notes and News*, and the sixth number of vol. v. contains much that concerns the bird protector. The frontispiece gives a view of St. Catherine's Lighthouse, which has now been fitted with racks and perches for the use of migrating birds, as before mentioned. There are two short articles on the plume trade from which much may be learned.

A serious falling-off in the supply of guano from the islands off the coast of Peru induced the Peruvian Government to enlist the services of Dr. H. O. Forbes, the well-known naturalist, with a view to the suggestion of remedial measures. Dr. Forbes, who reached Peru at the commencement of 1912, but was unable to get to work until late in that year, has recently returned to this country, and an account of his experiences and investigations appeared in *The Times* of July 25. The guano-islands form a chain of more than 1000 miles in length, commencing with the Lobos Islands in the north to a point off Mollendo in the south. In the breeding season they are the resort of countless thousands of gannets, cormorants, pelicans, and other sea-birds, the two most important species from a commercial point of view being Bougainville's cormorant (*Phalacrocorax bougainvillei*) and the pelican known as *Pelecanus thagus*. Each of these voracious birds consumes from 8 to 10 lb. of fish *per diem*, and the production of guano from the whole assemblage is consequently enormous. Dr. Forbes succeeded in calculating the product of each pair of birds and their offspring in a season, from which he was enabled to form an estimate of the amount for a period of, say, four years. "From that estimate he divided up the whole of the guano-archipelago into zones. He made certain practical suggestions for the protection of the birds with a view to allowing them to deposit and to have a rigorous close-season, and also a period of rest in each of four years. Only one zone would be worked every year, thus leaving a period for recovery." A remarkable event occurred just before Dr. Forbes's visit, almost the whole of the birds having deserted the islands in November, 1911, and not returning until February or March, 1912, leaving their young to perish from starvation. An unusually severe earthquake shock is considered by Dr. Forbes to have been the probable cause of the exodus, and he surmises that the birds may have betaken themselves northwards to the Galapagos Islands.

The supreme importance of birds to the agriculturist, as being in the main the only effective check on most of the insects by which crops are ravaged, is perhaps more fully and more generally recognised in the United States than in this country. Evidence of popular interest in this matter among our American cousins is afforded by the first article in the June number of *The National Geographic Magazine*, which is a reprint of a "Farmers' Bulletin," issued some years ago by the Agricultural Department, containing an account of fifty species of birds commonly frequenting American farms and orchards. In its new guise the article contains a coloured illustration, printed in the text, of each of these fifty species. Although small, the figures are beautifully executed, and form a striking instance of journalistic achievement.

In an illustrated article on national bird-reservations in the United States, published in the May number of *The American Museum Journal*, Prof. T. S. Palmer points out that, in addition to protected breeding places, refuges have been established in the west for birds while on passage. A reservation of this type "comprises merely a narrow strip of land bordering the reservoir, and is set aside to afford the birds a resting place on their journeys north and south. Some of these reservations were created before construction work was completed and before there was any water to attract the birds, in order to afford protection as soon as the reservoirs were filled and the birds began to visit them."

In an article on the velocities of migratory birds in the July number of *The Zoologist* Mr. F. J. Stubbs disputes the belief that migrants prefer to fly in the teeth of the wind, and likewise that they do so in order to escape the inconvenience of the wind ruffling their plumage by blowing obliquely through it from behind. The fact that head-winds undoubtedly bring most migrants has been a main argument in support of the former belief, but it is urged that such winds stop migration, and that birds flying under these conditions are really retarded. The "feather-ruffling" theory, on the other hand, is stated to be based on a misinterpretation of the fact that such birds as lapwings constantly stand head-to-wind in rough weather, and that if they happen to turn ruffling of their feathers ensues. For the author's arguments in support of his views, our readers must be referred to the article itself.

In an account of a recent visit to Phillip Island, published in *The Victorian Naturalist* for June, Mr. J. Gabriel states that sixty species of birds were identified, of which sixteen are sea or shore species, leaving forty-four as residents on the island, an excess of eight over a previous record. Protection, it is urged, is sorely needed for the mutton-bird and the little penguin, the numbers of which are rapidly diminishing owing to incessant persecution.

BLOOD-PARASITES.[1]

YOU will remember that Mephistopheles, when he insists upon the bond with Faust being signed with blood, says, "Blut ist ein ganz besondrer Saft" ("Blood is a quite special kind of juice"). Goethe would probably not have used the word "Saft" had he been writing "Faust" to-day instead of in 1808, for at that time the cellular elements of the blood—although they had been seen and described by Leeuwenhoek in 1686—were believed to be optical illusions, even by so distinguished a person as the professor of medicine of that time at the Sorbonne. The incredulity of scientific men as to what they see is proverbial and astounding, fortunately; but it is probably because science is really quite sure of nothing that it is always advancing.

I have the privilege this evening of trying to show you the barest outlines of our present knowledge of the parasitology of the blood. It is a subject of great practical and economic importance, as many grave diseases of man and beast are caused by these parasites, which, on account of their minuteness, enormous numbers, and very complex life-histories, are very difficult to eradicate or to deal with practically. On this account there is a good deal of the enthusiasm of the market-place mixed up with this subject, which, although a new one, has advanced with great rapidity, and has revolutionised pathology, and medicine so far as possible. From our point of view it began in 1880 with the discovery by Laveran, in the military hospital of Constantine, of the parasite which causes malaria. This caused the protozoa, to which order most of these parasites belong, to oust bacteria from the proud position they then occupied of being the cause of all the ills we have to bear, and to reign in their stead; not an altogether desirable change; for when you have seen what I shall show you, you will agree with me that sufficient unto life is the evil thereof. It has had all the disadvantages of a new subject, and since that time floods of work have been poured into journals, annals, proceedings, &c., some of it of the best, with much of it that is indifferent, temporary, and bad; so that at times it seems as if this branch of science were in danger of being smothered in the dust of its own workshop, or drowned in the waters of its own activity. We do not, nowadays, keep our ideas and scraps of work to ourselves until they are either established, or, as is more likely, dissipated, so we have a huge mass of what is called "literature," filled with many trivial, fragmentary, and doubtful generalisations, many of which we have with pain and trouble to sweep into the dust-bin: nature's blessed mortmain law taking too long to act. You remember Carlyle complained—to use a mild term—of Poggendorff's *Annalen*, and I feel sure that, if he had had to study blood-parasites now, he would have said that it was a much over be-Poggendorffed subject. Blood-parasites are afflicted, too, with terrible names, and with large numbers of them; some have as many as ten or even fifteen different names, perhaps on the Socratic principle, that naming saves so much thinking. And they are in Latin, too, so that the terminology of this subject is a perfect museum of long Latin and hybrid-Latin names. The terminology generally of our later biology is, as one has said, "the Scylla's cave which men of science are preparing for themselves, to be able to pounce out upon us from it, and into which we cannot enter." This will be my excuse if I should use words you do not understand.

I will just remind you of the structure of the blood, that it consists of an extraordinarily complex fluid—

[1] Abstract of a discourse delivered at the Royal Institution on Friday, May 2, by Mr. H. G. Plimmer, F.R.S.

the plasma—which holds in suspension living cellular bodies, called cells or corpuscles. These are of two kinds, red and white corpuscles. The red are by far the more numerous, and in man there are about 5,000,000 of them to a cubic millimetre of blood, but this number varies enormously under the influence of parasites. To these red corpuscles is due the red colour of the blood, and they are the carriers of oxygen, acquired by the aëration of the blood in the lungs, to the tissues. We breathe in order that they may breathe, for we only care about oxygen in so far as they care about it.

The other kind of corpuscles are the white, or leucocytes, and of these in health there are about 7500 per cubic millimetre. A few years ago it was enough to know that there were red and white corpuscles, but now we have to know more. Through the work of Ehrlich we know that there are at least five different kinds of leucocytes in normal blood, which I will just indicate to you.

(1) Lymphocytes.—These are the smallest cells, and contain a relatively very large nucleus.

(2) Large Mononuclears.—These are large, and are called macrophages, as they possess the power of being able to absorb and digest parasites and other foreign bodies.

(3) Polynuclears.—These are characterised by the irregular, moniliform aspect of their nucleus, and they are called microphages for the same reason that the large mononuclears are called macrophages. Both of these are also called generally, phagocytes, on account of their power of ingesting and digesting foreign bodies.

(4) Eosinophiles.—These are characterised by a bilobed nucleus, and by granulations which colour deeply with eosin and other acid colours.

(5) Labrocytes or Mastzellen.—These are rare, and are characterised by large granulations which stain with basic colours.

In parasitic diseases these corpuscles are profoundly modified and altered, numerically and morphologically, and other new elements may make their appearance in the blood.

The blood is essentially the same in all animals, but it varies within certain limits. For instance, the red corpuscles are not of the same size and shape in every animal, and in birds and fishes they are nucleated; in us they are only nucleated in fœtal life and in disease. The mononuclear and polynuclear leucocytes are really separate organisms living in us, and they have qualities which it is very difficult to call anything else but consciousness; so that it is a subtle distinction to draw the line between the parasites—which these leucocytes are, in a way—which are part of us, and those that are not. When the balance of power is well preserved amongst our leucocytes, when they are working well together, then all is well with us; if we are ill, it is because they are quarrelling with themselves or with an invader, and we send for Sir Almroth Wright to pacify or chastise them with his vaccines.

So that, as Darwin said: "An organic being is a microcosm, a little universe, formed of a host of self-propagating organisms, inconceivably minute and numerous as the stars in heaven"—as we ourselves are but parts of life at large.

The three main functions of the blood are: that it is a means of respiration, a means of nutrition, and a defence against invading organisms.

And now to these latter. A blood-parasite proper is a living being, vegetable or animal, passing part or the whole of its existence in the blood of another living being, upon which it lives, this being obligatory and necessary to its life-cycle.

It was in 1841 that the first blood-parasite was seen by Valentin in the blood of a fish, and two years later Gruby gave the name trypanosoma to an organism he found in the blood of a frog. But since Laveran's discovery of the malarial parasite in 1880, we have learnt to differentiate many other parasites as causal agents of such diseases as I shall mention later in connection with the various parasites. But we know as yet dangerously little about most of them, so that we have strenuously to resist the temptation to make our account of them sound too harmonious, before we have found half the notes of the chord we are trying to play. We speak, as it were, with authorised uncertainty, and there are parts of our science which, after all, are only expressions for our ignorance of our own ignorance. These parasites have a very complicated life-history; part of their life-cycle is passed in the blood of man or beast, and part in various parts of the body of some blood-sucking invertebrate, such as a fly, mosquito, or tick, which transfers the parasite to another animal whilst feeding from him. It was thought formerly that blood-parasites would be a restricted order, but the work of recent years has shown that they have an enormous distribution both geographically and as regards their hosts. For instance, during the last five years I have had the opportunity of examining all the animals (in the large sense of the word) which have died in the Zoological Gardens. I have examined the blood of more than 8000 animals, coming from all parts of the world, and I have found parasites in the blood of 587 of them, that is in about 7 per cent., and in 295 species of animals I have found them for the first time. I mention this just to give you some numerical idea of their occurrence and distribution.

It will be better to take first those parasites which live in the plasma, and then those that live in the corpuscles, rather than to attempt to take them in their, at present rather uncertain, biological order; and I will begin at the bottom, biologically speaking, that is with the bacteria which are plants. These only require mention, since they do not live in the blood as parasites proper, but only as accidental parasites—that is, parasitism is not necessary to their life-cycle; they get into the blood in the later, or in certain, stages of certain diseases.

An example is the blood of a Senegal turtle-dove which died in twenty-six hours from fowl cholera. This bacillus was discovered by Pasteur, and is interesting, as it was his work upon it which led to his discovery of the attentuation of a virus, and of its transformation thereby into a protective vaccine.

The first parasites proper I shall mention are the Spirochetes. These have at present rather an insecure position in our idea of nature; they were formerly classed close to the bacteria, but now they are placed tentatively among animals, and they are not yet quite sure of their place. But they, nevertheless, although insecure of their place in the books, produce grave diseases, such as relapsing fever, tick fever of man, the spirochetoses of horses, oxen, and birds, syphilis, and yaws. They, with the exception of the last two, are carried by, and developed in, ticks and bugs; and in tick fever the parasite is also found in the nymph form of the tick, and this is one of the rare instances of heredity of a parasite.

The spirochete of relapsing fever in man was discovered by Obermeier in 1868, and he died from inoculating himself with the blood of a patient with the disease. He was one of the first scientific martyrs; he established our knowledge of the cause of this disease at the expense of his own life.

We will now take a long jump to the Filariæ. These are nematode worms, the embryo forms of which live in the blood; the parent forms, being too large to get through the capillaries, live in many other parts of the body. The larval form lives in the body of some invertebrate—in a few known cases in a mosquito, or in a crustacean. The microfilariæ were discovered by Demarquay in 1863. Many of them show a remarkable periodicity, some appearing in the blood at an exact hour at night, and some in the day, for which phenomenon there is at present no satisfactory explanation.

Some are short, and some long, and some are encapsuled, others not. Filariæ cause various diseases, probably elephantiasis, and certainly enormous varicosities of the lymphatics, chyluria, chylous dropsy, Calabar swelling, and certain tumours.

We now come to the trypanosomes. They are flagellated organisms, which are the cause of many deadly diseases in men and animals, such as sleeping sickness, nagana (or tsetse-fly disease), surra, mal-de-caderas, dourine, and others. They are transferred from animal to animal by biting flies, fleas, lice, and leeches, in which the sexual part of their life-cycle takes place. The first one was seen in the blood of a frog by Gluge in 1842.

A type example is *T. lewisi* in the blood of a rat. This was discovered by Lewis in 1878, and is found in about 25–29 per cent. of wild rats. Some die, but most recover and become immune; it is a very specific parasite, and cannot be transferred to any other kind of animal.

The *T. brucei*, causing nagana or tsetse-fly disease, probably exists in the wild game of South Africa, much as the *T. lewisi* does in the wild rats, but when it is carried by the tsetse-fly to domesticated animals it kills them one and all in enormous numbers.

The *T. gambiense*, which causes sleeping sickness, was first seen by Dutton in 1902, and is carried by another species of tsetse-fly.

Nature attempts to fight against these invaders by phagocytosis. The parasites, however, multiply so rapidly that this method of attack is not very effectual; it can only be so in very early infections, and probably it then often is, that is, before the parasite has had time to start dividing. At the present time the question of trypanosomosis amongst man and animals is, for many countries which have colonies, of the greatest economic importance, so that a great deal of work has been done in the attempt to find a cure. A great many drugs, new and old, have been tried, and some good has been done. The first drug which was found to be of service was arsenic, first in simple and then in complex combination, and the subcommittee of the Royal Society, formed for the purpose of supervising experiments in this direction, suggested the trial of antimony in these diseases, on account of its near chemical relationship to arsenic.

This has given better results than arsenic, and a commission is at present at work in Africa, in the Lado district, trying its effects on a large scale. We found that the salts of antimony were too rapidly eliminated from the body to be successful in the larger animals and man, and so we devised a very finely divided form of the metal itself which we put directly into the circulation, and this has given, so far, the best results. The leucocytes eat it up and transform it slowly into some soluble form, taking, in a horse, for instance, four days to dispose of one dose, and the effect of this is much more profound and lasting than that of the salts. But some trypanosomes always escape, since one dose is never sufficient for cure. In rats with nagana, in which the trypanosomes by the fifth and sixth day may number 3,000,000 per cubic millimetre of blood, the minimum number of doses for cure has been found to be four, and with this dosage it is possible to cure 100 per cent. of rats. So there is still some hope.

It is interesting in this connection to remember what Bacon, whose death, you know, was due to an experiment he undertook to prove the preservative action of intense cold upon animal bodies, says, "Laying aside therefore all fantastic notions concerning them, I fully believe, that if something could be infused in very small portions into the whole substance of blood . . . it would stop not only all putrefaction, but arefaction likewise, and be very effectual in prolonging life." His vision was prophetic!

The bird trypanosomes are very much larger than the mammalian variety, are very dense, and move much more slowly.

An example of an organism very closely allied to the trypanosomes which is found only in fishes' blood is the trypanoplasma. It has two flagella, and the micronucleus is very large. This organism is probably transferred by leeches, but very little is yet known of it.

There are other flagellated organisms which may appear in the blood and live there as accidental parasites. There is a kind of inflammation of the intestines in reptiles (in the large sense) which causes the mucosa of the intestine to become permeable, so that some of the organisms which live in the intestine are able to get into the blood and live there. The only mention of these organisms in the blood is by Danilewsky, who in 1889 found hexamitus in the blood of a frog and tortoise. When in the blood they appear to excite a general œdema and ascites. I have found them now in nine cases. These are interesting as showing the power of adaptation to new surroundings possessed by these parasites.

I now come to the intracellular parasites.

Schaudinn thought that the bird trypanosomes had an intracellular stage, and if this were so they would form a bridge between the extra-cellular parasites, of which I have shown you types, and the intracellular parasites we are about to consider. But Schaudinn seemed, with his very brilliant attainments, to want a little more ballast of medical earth-knowledge. His work on this point has not been confirmed, and he was probably misled by a double, or even treble infection, so that we must think of these intracellular parasites as quite distinct from the others.

I will take first the *Plasmodium praecox*, the cause of the malaria in birds, as this parasite is of great historical interest; for it was Ross's work on this organism and his discovery of the rest of its life-cycle in the mosquito, which enabled him—on account of the great likeness between this and the parasite causing human malaria—to deduce from the one the etiology of the other, which was confirmed by Grassi and others. The *Plasmodium praecox* is, in many stages, so like human malaria that it can only be differentiated by the presence of the oval nucleus of the bird's red corpuscles. The life-cycle is very complex, part taking place in the blood of the bird, and another part (sexual reproduction) in the body of a mosquito. This parasite was first seen by Grassi in 1890; it is very widely distributed, and is very deadly to birds.

Human malaria has been known for centuries. Varro, who knew a good deal about what we should now call hygiene, more than a century B.C., thought that malarial fevers were due to invisible animals, which entered the body with the air in breathing, and Vitruvius, Columellus, and Paladius were of the same opinion. Now we know that the mosquito is again the carrier, and that the sexual part of the parasite's cycle takes place in it, but whether the mosquito alone can account for all the phenomena of malaria is not yet quite certain.

There are three varieties of malaria in man—the tertian, quartan, and quotidian; in the tertian the cycle of the parasite in the body takes forty-eight hours, and in quartan seventy-two hours, and in pernicious malaria the fever is very irregular, but continuous. Whether there are three different parasites, or only one, which is altered according to its environment of host, climate, &c., is still apparently uncertain. Laveran and Metchnikoff believe in the specific unity of the parasite, whereas some observers want as many as five different species.

Just as in human malaria the pernicious form is distinguished by the elongated form of its gametes, so in birds there is a parasite which is distinguished, in the same way, from *Plasmodium praecox* by its very elongated gametes. This parasite is called *Haemoproteus danilewski*. Its development is unknown; it begins as a tiny, irregular body in the red corpuscles of the bird, then it grows in the long axis of the cell and turns round the end of the nucleus. It is possible in these parasites to follow the process of impregnation, which normally takes place in some insect. By taking the blood when full of the long, fully-grown gametocytes, and keeping it for a time outside the body, this process can be followed.

First of all, the gametocytes escape from the blood-corpuscles and roll themselves up into a ball. Some of these remain quiet—the females, curiously, the macrogametocytes—whilst in the microgametocytes active movements are seen; then tailed processes are seen projecting from its surface, which at last get free and wander about in the blood, this constituting the origin of the microgametes from the microgametocyte. They then find a macrogamete, and penetrate into it and fertilise it. This fertilised macrogamete then alters its shape and becomes an oökinete, with the remains attached containing the pigment. It may enter a red corpuscle, but it usually breaks up, because it finds it is not in the stomach of the insect it intended to be in, but between two pieces of glass.

From Hæmoproteus it is easy to pass to a rare and undetermined parasite of the blood of birds called a Leucocytozoon. It occurs in the blood in the form of a long, spindle-shaped, unpigmented body. Very little is known of it except that it is found in its sexual forms. The earliest observers of this parasite—Danilewsky and Ziemann—believed the host-cell to be a leucocyte (hence the name), but Laveran has shown that it is a red corpuscle.

We now come to a group of parasites of great practical importance, the Babesias, formerly called Piroplasma, which are the cause of Texas fever or red-water fever, malignant jaundice, East Coast fever, and biliary fever amongst domestic animals. We know, again, little that is certain concerning this group, except that they are unpigmented parasites of the red corpuscles, and are carried by ticks. They are the most destructive to the blood of any we know. In an ox, I have seen the red corpuscles decrease from 8,000,000—the normal—to 56,000 per cubic millimetre in two days.

Another important group, the Leishmania, is still uncertain of its exact position. In the body they occur as small bodies with a nucleus and micronucleus, but when cultivated on artificial media they become flagellated organisms of herpetotomas type. It is not quite certain what insect plays the part of carrier, but the different varieties of this group cause the diseases known as Kala Azar or tropical splenomegaly, Oriental sore, Delhi boil, Biskra boil, &c., and also infantile splenic anæmia.

The last class are the Hæmogregarines. These are parasites of the red corpuscles of reptiles principally, but they have been described in mammals and birds. We only know certain stages of the greater part of them; they are large, sausage-shaped bodies, not pigmented, and they are supposed to be carried by leeches, ticks, lice, and fleas. They generally have a capsule. In some instances the host-cell is enormously enlarged and entirely dehæmoglobinised, but in most cases the host-cell is not enlarged.

I have now taken you over some examples of all the known types of blood-parasites, but, at best, the picture in your minds must be like that of a landscape taken from a railway carriage at full speed; and the result, I fear, only a kind of clarified confusion, but it will be something if I have succeeded in making it transparent at the edges. What must have struck you most is the smallness of our exact knowledge of many of these extraordinary organisms and the gaps that there are even in this. But the incitement to future work lies in this fact, for

"Things won are done, joy's soul lies in the doing."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

At University College, Reading, Mr. S. B. McLaren, assistant lecturer in mathematics at Birmingham University, has been appointed professor of mathematics, and Mr. R. C. McLean lecturer in botany.

An article dealing with the number of students at German universities during the session 1912–13 is contributed by Prof. Rudolf Tombo, junior, of Columbia University, to the issue of *Science* for July 18. The total number of matriculated students was 58,844, and, including auditors, the total reached 64,590. Of the matriculated students 3213 were women, of whom 904 attended the University of Berlin. Of the male matriculated students 26,988 were studying philosophy in the various universities. The largest number of matriculated students, namely 9806, was enrolled at Berlin. The Universities of Munich and Leipzig had 6759 and 5351 students respectively, and Bonn 4179. There were sixteen other universities with from one to three thousand matriculated students. The largest enrolment of foreign students was found at Berlin, where there were 1605, while Leipzig, Munich, Halle, Heidelberg, and Königsberg had numbers from 784 in the first to 244 in the last-mentioned case. Altogether there were 5193 matriculated foreigners enrolled at the German universities; of these 4648 were from Europe, 338 from America, 184 from Asia, twenty-two from Africa, and one from Australia. Of the European countries, Russia had the largest number of students, 2840, Austria had 900, Switzerland 340, and Great Britain 145.

The following announcements relating to the Imperial College of Science and Technology, South Kensington, have reached us:—Mr. Otto Beit has announced his intention to found three fellowships for scientific research to be held at the college. Mr. Beit's intention in founding these fellowships is to foster only the highest research. The fellowships will be limited to Europeans, men or women, who have graduated at universities in the British Islands, Colonies, and Dominions, or are recognised by the trustees to be of the same standing. The annual value of each fellowship is not to exceed 150*l*.—Prof. S. M. Dixon, professor of civil engineering at the University of Birmingham, has been appointed to the new chair in civil engineering in the City and Guilds (Engineering) College. The department in the City and Guilds (Engineering) College which has hitherto covered the subjects of civil and mechanical engineering will next session be divided into two departments, one dealing with mechanical engineering and motive power, under Prof. Dalby, and the other with civil engineering, including theory of structures, hydraulics and hydraulic machinery, ferro-concrete construction, docks, water supply, and surveying, under Prof.

Dixon.—Prof. H. C. H. Carpenter, professor of metallurgy in the Victoria University of Manchester, has been appointed to the chair of metallurgy in the Royal School of Mines. Mr. S. J. Truscott has been appointed assistant professor of mining. These changes form part of a complete scheme of staff and curriculum reorganisation in the Royal School of Mines now being carried out. The work of the school will be transferred in October to the commodious pile of buildings now approaching completion in Prince Consort Road, South Kensington.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 21.—M. F. Guyon in the chair.—B. **Baillaud,** as president of the Bureau des Longitudes, presented the results obtained by the French committee charged with the execution of the preliminary operations relating to the measurement by wireless telegraphy of the difference of longitude between Paris and Washington, made under the direction of MM. Renaud and Bourgeois. The preliminary results include the determination of the time of transmission of the signals between the Eiffel Tower and Arlington (6175 kilometres), 0·0315 second, and the differences of longitude and colatitudes observed by the observers attached to the French Navy and Army independently. The signals emitted by Paris were received at Arlington with a sufficient intensity to be registered photographically.—J. **Boussinesq**: A new demonstration of the formula of surface potential energy in perfect liquids.—Armand **Gautier** and P. **Clausmann**: A remarkable condition of the attack of quartz by gaseous hydrofluoric acid. It had been noticed in some work on the determination of fluorine that quartz was scarcely attacked by quantities of hydrofluoric acid a hundred times greater than the amount giving a good etching on glass. It has now been found that the position of the surface of quartz under attack by the acid with respect to the axis of the crystal causes large variation in the amount of corrosion produced. Taking the attack of glass as 1000, that of fused quartz is about 100; quartz cut parallel to the axis is 11, cut perpendicular to the axis about 1.—A. **Haller**: The production of tetra-alkyl derivaties of the α or 1-methyl*cyclo*hexanone.—G. **Gouy**: The conditions of equilibrium of the solar atmosphere with respect to the repulsive force of radiation.—Magnus de **Sparre** was elected a correspondant of the academy for the section of mechanics in the place of M. Bazin, elected non-resident member.—René **Baillaud**: A new method of determining the horizontal flexure of meridian instruments.—M. **Fessenkoff**: Photometric observations on the zodiacal light.—F. S. **Zarlatti**: Some singular integral equations.—J. A. Le **Bel**: The catathermic radiation.—V. **Schaffers**: Electrical conduction in cylindrical fields under atmospheric pressure.—MM. **Massol** and **Faucon**: Absorption of the ultra-violet radiations by some organic colouring matters in aqueous solution.—H. **Gaudechon**: The relation between the thermal effect accompanying the immersion of dry powders in liquids and the aptitude of the latter to form associated molecules. Dried clay, starch, silica, and charcoal on addition to water or various organic liquids give off a certain amount of heat. This has been determined, and it is shown that with normal, non-associated liquids the temperature rise is very small; with associated liquids the heat evolution is greater.—Gabriel **Bertrand** and G. **Weisweiller**: The composition of coffee extract: the presence of pyridine. Amongst the products of coffee infusion to which the aroma is due pyridine has been found, and in a proportion greater than any other volatile constituent. The possibility of this base playing an appreciable part in the physiological action of coffee is discussed.—A. **Damiens**: Study of the action of water on the carbides of the rare earths. The carbides of cerium, lanthanum, neodymium, praseodymium, and samarium were studied, the hydrocarbons being analysed by the method recently described by Lebeau and Damiens. The primary reaction between the water and carbide is—

$$C_2M + 3H_2O = M(OH)_3 + C_2H_2 + H_2.$$

Ethylene and ethane are formed by the interaction of some of the hydrogen and acetylene, but no trace of methane is found.—J. **Clarens**: The spontaneous transformation of hypochlorites into chlorates and of hypobromites into bromates.—A. **Mailhe**: The catalytic preparation of the ketones with oxide of iron. At temperatures between 430° and 490° C. in presence of oxide of iron vapours of the fatty acids are catalytically converted into ketones, carbon dioxide and hydrogen being simultaneously evolved. Mixtures of benzoic acid with fatty acids give good yields of the mixed ketones. The worst yields were obtained with *iso*valeric and *iso*butyric acids.—H. **Giran**: Researches on sulphuric acid and sulphuric anhydride.—Paul **Lebeau** and Marius **Picon**: The action of sodammonium on phenylacetylene and styrolene. The reaction differs from that recently proved for acetylenic hydrocarbons of the fatty series, phenylacetylene giving ethylbenzene by reduction.—Jacques **Bardet**: The spectrographic study of French mineral waters. The salts from fifty-four springs have been examined using the arc spectra. Lead was found in all the samples, silver and tin in most of them. Germanium and gallium were found in a considerable number, and amongst other elements not usually mentioned as constituents of mineral waters were molybdenum, copper, antimony, cobalt, chromium, mercury, nickel, gold, thallium, vanadium, and tungsten.—M. **Gard**: The sexual elements in the vine.—Marcel **Delassus**: The influence of the partial suppression of the food reserves of the seed on the anatomy of the plant. Removal of part of the reserves of the seed results in development on a reduced scale, the differentiation of the tissues is retarded, and the number of fibro-ligneous bundles of the stem is diminished.—**Audebeau** Bey: The permeability of Egyptian soils.—J. **Winter**: The total volume of the gastric juice secreted during digestion.—G. **Bourguignon** and H. **Laugier**: The apparent differences of polar action and localisation of the stimulation on closing the circuit in Thomsen's disease.—Miromond de **Laroquette**: A new method for discovering foreign bodies in the tissues. The apparatus described is simple to use, and permits of the discovery of the exact position of the foreign body in less than one hour.—M. **Gerber**: The identity between the rennet, casease, and trypsin of one and the same latex. The existence of two types of proteolytic plant ferments.—Pierre **Thomas** and Mme. Sophie **Kolodziejska**: The proteid substances of yeast and their products of hydrolysis.—H. **Bierry** and Mlle. F. **Coupin**: *Sterigmatocystis nigra* and lactose.

NEW SOUTH WALES.

Linnean Society, May 28.—Mr. W. S. Dun, president, in the chair.—Dr. A. Jefferis **Turner**: Studies on Australian Micro-Lepidoptera. This contribution is intended to be a supplement to Mr. Meyrick's revisional paper on the Plutellidæ (Proceedings of the Linnean Society of New South Wales, 1907, p. 47). Additional localities for known species are given, and a number of species are described as new.—R. J. **Tillyard**: Some descriptions of new forms of Australian Odonata. This paper adds four new species, three new subspecies, and the hitherto unknown female of *Diphlebia hybridoïdes*, Tillyard, to the list of Australian Odonata.—H. **Maiden** and E. **Betche**: Notes from the Botanic Gardens, Sydney. No. 18. Seven new species are proposed. Notes on proposed new varieties, plants new for New South Wales, and plants with interesting new localities are given.—Mr. **Tillyard**: Study of zoo-geographical distribution by means of specific contours. In this method, instead of attempting to subdivide the recognised zoo-geographical regions into distinctly marked-off sub-regions and lower divisions, it is proposed to study the various groups of plants or animals occurring over the whole region, by constructing "specific contours" by the following rules:—(1) The group selected must be a *natural* group, *i.e.* a genus, tribe, or family which forms a homogeneous whole, and not merely a group separated off for convenience of classification. (2) The records available must be sufficiently numerous to give the *general form of the contour*, but absolute accuracy is neither attainable (without infinite labour) nor necessary. (3) Each species of the selected group is reckoned as a unit. On the map of the region under study, against each locality which has been "worked," the number of units occurring there is to be put down. Then contour lines, in the form of free curves, are to be drawn so that all localities having an equal number of units shall be between any two successive contour lines.

BOOKS RECEIVED.

Department of Applied Statistics, University College, University of London. Drapers' Company Research Memoirs. Biometric Series VIII.:—A Monograph on Albinism in Man. By K. Pearson, E. Nettleship, and C. H. Usher. Part ii., Text. Pp. 265–524. Part ii., Atlas. Plates a.–w. and a.a.–n.n. (London: Dulau and Co., Ltd.) Text and Atlas, 30*s.* net.

Smithsonian Institution. U.S. National Museum. Bulletin 81:—Synopsis of the Rotatoria. By H. K. Harring. Pp. 226. (Washington: Government Printing Office.)

Memoirs of the Geological Survey of India. Vol. xli.:—The Coalfields of India. By the late Prof. V. Ball. Entirely revised and largely rewritten by R. R. Simpson. Pp. 147+xliv+20 plates+map. (Calcutta: Geological Survey of India; London: Kegan Paul and Co., Ltd.) 5 rupees, or 6*s.* 8*d.*

Transactions of the Royal Society of Edinburgh. Vol. xlix. Part 1. Session 1912–13. Vol. xlviii. Part 3. Session 1912–13. Vol. xlviii. Part 4. Session 1912–13. (Edinburgh: R. Grant and Son; London: Williams and Norgate.) 7*s.* 6*d.*, 31*s.*, and 16*s.* 8*d.* respectively.

The Standard of Value. By W. L. Jordan. Eighth edition. Pp. vi+287. (London: Simpkin and Co., Ltd.) 7*s.* 6*d.* net.

Practical Physics for Secondary Schools. By N. H. Black and Dr. H. N. Davis. Pp. viii+487. (London: Macmillan and Co., Ltd.) 5*s.* 6*d.* net.

British Pharmaceutical Conference. A Presidential Survey. 1863 to 1913. Pp. 96. (London: *The Chemist and Druggist.*)

On the Circulation of Energy and Matter. By E. M. Darken. Pp. 27. (Wellington, N.Z.: P.O. Box 266.)

Report on Scottish Ornithology in 1912, including Migration. By L. J. Rintoul and E. V. Baxter. Pp. 96. (Edinburgh: Oliver and Boyd.)

The National Physical Laboratory. Report for the Year 1912. Pp. 123. (Teddington: W. F. Parrott.)

The National Physical Laboratory. Collected Researches. Vol. ix., 1913. Pp. iv+245+plates. Vol x., 1913. Pp. iv+253+plates. (Teddington: National Physical Laboratory.)

Merck's Reagenzien-Verzeichnis. Dritte Auflage. Pp. 446. (Berlin: J. Springer; London: E. Merck.) 6*s.* 6*d.*

Organic Chemistry for Advanced Students. Vol. ii. By Prof. J. B. Cohen. Pp. vii+427. (London. E. Arnold.) 16*s.* net.

Die chemische Verwandtschaft und ihre Beziehungen zu den übrigen Energieformen. By Dr. Max Speter. Pp. 134. (Leipzig: P. Reclam, jun.) 2 marks.

Phonetic Spelling: a Proposed Universal Alphabet for the Rendering of English, French, German, and all other Forms of Speech. By Sir H. Johnston. Pp. 92. (Cambridge University Press.) 3*s.* 6*d.* net.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye"—WORDSWORTH

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THURSDAY, AUGUST 7, 1913.

MANIHOT RUBBER.

Der Manihot-Kautschuk. Seine Kultur, Gewinnung und Präparation. By Prof. A. Zimmermann. Pp. ix+342. (Jena: Gustav Fischer, 1913.) Price 9 marks.

THE subject of rubber cultivation is one which has received much attention during recent years. Hitherto the Middle East has confined its attention almost entirely to the cultivation of *Hevea brasiliensis*, rather than that of Manihot, which is the subject of Dr. Zimmermann's book. Manihot is not regarded in the Middle East as being so profitable to cultivate as *Hevea brasiliensis*, but it certainly takes a very high place among the arborescent forms of rubber-yielding plants in virtue of its rapid rate of growth, its hardy characteristics, and quality of rubber.

Four species are dealt with by the author, viz., *Manihot Glaziovii*, Müll. Arg.; *M. dichotoma*, Ule; *M. piauhyensis*, Ule; *M. heptaphylla*. The first species is that which has been most largely distributed throughout the tropics, and is the source of "Ceara" rubber of commerce. The other species have only recently come into prominence, mainly as the result of the work of Dr. Ule in tropical America.

A full description is given in chapter ii. of these species and their natural habitats. The cultivation in different countries, the variability of the plant, its anatomy, morphology, and diseases of various parts are also dealt with. An interesting diagram is shown, giving a good idea of the distribution of the bands of laticiferous tissue. A transverse section through the cortex and bark of *Manihot Glaziovii* shows the connected tangential bands of laticifers near the cambium being broken up as one passes outwards; in fact, from this transverse section one would be inclined to infer that if the tapping instrument was pressed deep enough it would, on every occasion (except where it touched a medullary ray), puncture a laticiferous vessel, and thus give rise to an exudation of latex.

An instructive chapter deals with the various methods of tapping, and a series of diagrams showing the half spiral, half herring-bone, full herring-bone, full spiral, and "V" tapping is given. Some of the tapping implements depicted are somewhat out of date, but will prove of interest to the general reader. Various systems of tapping, including pricking and vertical incisions, are very well illustrated.

The last six chapters of the book (xvi. to xxi.) deal with the general research which has been done in connection with rubber, and go somewhat deeply into the problem of tackiness, colour, and preparation of rubber. Even an account is given of the proceeds and revenue from plantations, and of the further uses of rubber trees. The book therefore covers a very wide field, and should prove of great interest to all connected with the rubber industry. Dr. Zimmermann's book will probably stand out for some time as one of the best on species of Manihot.

H. W.

COMPARATIVE ANATOMY.

Vorlesungen über vergleichende Anatomie. By Prof. Otto Bütschli. 2. Lieferung: Allgemeine Körper- und Bewegungsmuskulatur; Elektrische Organe und Nervensystem. Pp. iv+401—644. (Leipzig: W. Engelmann, 1912.) Price 9 marks.

THE first volume of these lectures was reviewed in NATURE in July, 1911, and attention was directed to the comprehensive scope of the work, the lucidity of exposition, and the excellence of the simple semi-diagrammatic illustrations. These qualities are fully maintained in the second volume, which deals with the muscular and nervous systems.

In a work covering such an extensive field of investigation it is quite impossible for one man to acquire a first-hand knowledge of all the material of which he treats, or even to do more than sample the voluminous flood of literature dealing with all the subjects discussed in such lectures as these. In such circumstances it would be easy for the specialist in any one branch of research to criticise the facts and inferences, and in many cases also the choice of interpretations borrowed from other writers. But such defects, which are, of course, inevitable, are more than compensated by the broad, well-balanced, and consistent view the general reader obtains when one competent writer surveys the whole subject.

In recent years intensive specialisation has made most of our text-books a badly-fitted patchwork of the scraps of knowledge which a host of authors has garnered, each in his own patch of cultivation; and most students and teachers have become only too familiar with the ill-jointed and distorted ideas such books convey. In studying such lectures as Bütschli's, even if one admits that the detailed information may not be as accurate as can be obtained in the patchwork type of book by several authors, the reader gets a truer perspective, and sees the facts blended into a picture which, on the whole, is a closer representation of the facts of nature than a collection of more accurate scraps of knowledge not properly assimilated one to the other can possibly be. Those biologists who find it a matter of the utmost difficulty to keep abreast of the growth of knowledge in one small corner of the vast field of comparative anatomy can alone appreciate the magnitude of the task Prof. Bütschli has accomplished in these volumes. For a man who has built up a deservedly great reputation by original investigation in the domain of protozoology to write the best comparative anatomy of the Vertebrates is surely an achievement that is not likely to be repeated.

G. E. S.

RESUSCITATION.

Resuscitation from Electric Shock, Traumatic Shock, Drowning, Asphyxiation from any cause by means of Artificial Respiration by the Prone Pressure (Schaefer) Method. By Dr. C. A. Lauffer. Pp. v+47. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1913.) Price 2s. net.

IN this little book of forty-seven pages Dr. Lauffer, the medical director of the Westinghouse Electric and Manufacturing Company, East Pittsburg, deals with the subject of artificial respiration as applied to resuscitation in electric shock. Dr. Lauffer is an enthusiastic advocate of the prone pressure (Schaefer) method of resuscitation, and his enthusiasm appears to be based upon considerable experience. He narrates several cases which have come under his immediate notice in which it has been successfully employed: one of concussion of the brain, with unconsciousness and failure both of heart and respiration, requiring an hour's application of the method: two severe cases of electric shock; one of suffocation from smoke, in which life appeared to be extinct; one of an injury to the head, in which respiration was completely arrested and the patient would have died but for the prompt assistance of artificial respiration on the part of one of the men whom he had instructed who happened to be present; and one of drowning. In addition to these cases, he states that he knows a man who has resuscitated six victims of electric shock, all of which cases would have been fatal but for his prompt and efficient efforts at artificial respiration. The author adds, "This man is an enthusiastic advocate of the prone pressure method."

Dr. Lauffer does not, it will be seen, confine himself to those cases in which he is more immediately interested, but has carried on his observations on cases of asphyxia from whatever cause. He points out the various circumstances in which artificial respiration may be necessary, including asphyxia arising from poisoning from carbon monoxide, ammonia fumes, gasoline fumes, sewer gas, suffocation by smoke, inhalation of confined air, inhalations of chloroform and ether, overdoses of laudanum, shock from a heavy blow on the abdomen, and apparent death from drowning. He explains the process of respiration, and gives a clear account of the manner in which artificial respiration should be performed. He especially emphasises the fact that by the prone pressure method resuscitation can easily be carried out by a single individual and without the aid of any extraneous apparatus; even if the operator be a mere boy and the victim an adult, the boy can utilise more than 80 per cent. of his weight by raising his knees from the ground and supporting himself entirely on his toes and the heels of his hands, the latter being properly placed over the floating ribs of the patient. He might perhaps have added that if the boy were to kneel directly upon the back of the patient, an even larger proportion of the operator's weight might be utilised.

Dr. Lauffer has never seen a case of fracture of the ribs or any damage to internal organs arise from the prone pressure method. He considers that the teaching of the subject should be made a part of every gymnastic course, especially in college and Y.M.C.A. gymnasiums and in Boy Scout organisations (which we believe is already the case in this country); he states that it is employed in the United States Army as part of the setting-up exercises.

The author further deals with the question of supplementary assistance which might be rendered if there is any second person to assist, but rightly points out that nothing must be allowed to interfere with the immediate application of artificial respiration, nor should this be desisted from nor the patient permitted to get up until his breathing has become regular. Dealing with the question of mechanical assistance, whilst not averse to the employment of any such assistance if it is immediately available, he points out that extravagant claims are made for various mechanical devices, and that, since such devices may be too remote, or when procured may be out of order, he concludes that there is nothing so dependable as the hands of a man's friends, and that no reliance can be placed on any outfit that cannot be carried with every electrical workman and which is not instantly available.

We commend Dr. Lauffer's little book to all who are interested in the subject.

MATHEMATICAL TEXT-BOOKS.

(1) *A School Algebra.* By F. O. Lane and J. A. C. Lane. Pp. viii+333. (London: Edward Arnold, n.d.) Price 3s. 6d.

(2) *A Treatise on Hydromechanics.* Part ii. Hydrodynamics. By A. S. Ramsey. Pp. xiii+360. (London: G. Bell and Sons., Ltd., 1913.)

(3) *Les Appareils d'Intégration.* By H. de Morin. Pp. 208. (Paris: Gauthier-Villars, 1913.) Price 5 francs.

(4) *Einführung in die höhere Mathematik für Naturforscher und Aerzte.* By Dr. J. Salpeter. Pp. xii+336. (Jena: Gustav Fischer, 1913.) Price 12 marks.

(5) *Elements of the Precision of Measurements and Graphical Methods.* By Prof. H. M. Goodwin. Pp. 104. (London: Hill Publishing Co., Ltd.; New York: McGraw-Hill Book Co., 1913.)

(6) *Matrices and Determinoids.* By Prof. C. E. Cullis. Vol. i. Pp. xii+430. (Cambridge University Press, 1913.) Price 21s. net.

(1) MESSRS. LANE'S "Algebra" looks as if it would prove a useful school-book. In dealing with the binomial and exponential series the authors state certain properties, with the explicit warning that they are not proving them. This is as it should be; but the chapter on exponentials and logarithms is not so clear as it might be; in particular, Arts. 135-7 would be better if arranged in the reverse order. In the earlier pages we have the old fallacious and meaningless statement: "to multiply a number a by a second number b, we do to a what is done to the unit to obtain b." It would be much better to give the rule of signs as a rule pure and simple, and then to show by cases of $(a-b)(c-d)$ that it does actually work out in practice. There are hundreds of examples—some, alas, of a highly artificial character; for instance, "If the hypotenuse of a right-angled triangle is x, and the other sides are y and z units of length, show that

$$1/\log_{x+z}y+1/\log_{x-z}y=2,"$$

or, again:

"Multiply $3\sqrt{xy^3}-xy+2\sqrt{y^5x^{-1}}$ by $\sqrt{x^3y}-2\sqrt{xy^3}$."

The most interesting chapters in the book are those on simultaneous equations, which are illustrated by appropriate graphs.

(2) Mr. Ramsey's "Hydrodynamics" is a treatise specially suited for university candidates, and as such may be highly praised for its clearness, elegance, and helpfulness. The chapter on discontinuous motion is exceptionally good, the cases discussed being worked out in unusual detail. The book includes a chapter on vibrations of strings, and one on sound waves; there is a large number of excellent examples, with their sources indicated; and sufficient references are given to original memoirs. As a text-book for capable students, Mr. Ramsey's work will be very hard to improve upon, and is certain to have a favourable reception.

(3) Mr. de Morin describes various kinds of planimeters, integrometers, integraphs, harmonic analysers, and compound integrators. We have summaries of the mathematical theories involved, diagrams of the mechanisms, and pictures of the different machines that have actually been constructed. No written account can be equivalent to inspection and use of the machines themselves; allowing for this fact, the author seems to have done all that could be expected. By the way, we wonder what the author of "Erewhon" would have said if he had been shown machines for doing sums, and predicting tides, and calculating moments of inertia.

(4) Dr. Salpeter's work is chiefly interesting as an example of a course in higher mathematics for medical men and men of science drawn up by an author acquainted more or less with modern pure mathematics. As might be expected, he appeals mainly to intuition; but he gives a whole introductory chapter to the notion of a limit, he proves $\partial^2z/\partial x\partial y=\partial^2z/\partial y\partial x$, when it can be proved, by the mean value theorem, and gives in an appendix some examples of discontinuous functions. For some reason, not apparent, there is a chapter on the second law of thermodynamics; in other respects the scope of the book is not of an unfamiliar kind; we have differential and integral calculus treated separately, then ordinary differential equations of the second order, and then some easy cases of definite integration. Naturally, many of the examples are chosen to illustrate physical or chemical formulæ.

(5) Dr. Goodwin's work is based on a course given by him for years past in the Massachusetts Institute of Technology. The sort of problem he deals with is such as: "Calculating g from π^2l/t^2, how closely should l, t be measured, so that the resulting value of g may be true within 0·1 per cent.?" He quotes, without proof, certain results of the theory of errors; in other respects the discussion is quite elementary, and includes a section on graphical methods. We can quite believe that a course of this kind has been of great value to the Massachusetts students; whether an actual course is given or not, laboratory students must become familiar with the connection between the probable values of their data and the probable value of their result. Dr. Goodwin gives a set of seventy-nine unsolved questions, which teachers of physics would find very useful exercises.

(6) Prof. Cullis associates with any rectangular

matrix an expression he calls its determinoid. This is, in fact, a sum of maximum determinants, taken from the matrix, with a rule of sign for each. There can be no doubt of the value of the theory of matrices, and that a good book on the subject is a desideratum. Whether the notion of a determinoid is likely to be anything like so valuable is a doubtful question, and we confess that we would rather have had a treatise on matrices alone. The present volume ends with a chapter on the solution of any system of linear equations, and to read this first of all is perhaps the best way to become favourably impressed by the treatise. The earlier chapters seem rather diffuse, and contain a large number of new technical terms, some of which, like "corranged," are not at all attractive. The next volume will contain applications to algebra and geometry, besides a discussion of matrix equations of the second degree. When this appears it will be easier to form a judgment on the work as a whole; meanwhile, we can see that it contains a great deal of valuable matter expressed in one consistent notation.

G. B. M.

OUR BOOKSHELF.

Brands Used by the Chief Camel-owning Tribes of Kordofan. (A Supplement to "The Tribes of Northern and Central Kordofan.") By H. A. MacMichael. Pp. viii + 40 + xvii plates. (Cambridge University Press, 1913.) Price 6*s.* net.

Nearly thirty years ago Robertson Smith lamented that no good collection of *wasm* (the tribal marks with which every Arab tribe brands its cattle) had been made, and now Mr. MacMichael has published as a pendant to his history of the Arab tribes of Kordofan a collection of the marks used by these tribes as camel brands. The utility of such a work to the members of the Sudan Civil Service is too obvious to need accentuation, but there is also a good deal of scientific interest attaching to it, although the writer's experience in the Sudan makes him regard it as improbable that the high hopes cherished by Robertson Smith will be realised, that such collections will enable us to trace the ancient history of the people.

No doubt each tribe, or each section of a nomad tribe, once had a distinctive brand, but it seems that in many cases this has been lost, or at least has fallen into disuse. The brands themselves are for the most part named after common objects, such as *bersham*, the "cross-hilt of a sword," and *bab*, "a door," while others derive their names from the part of the camel which is branded; thus, *bakkai*, derived from the word meaning "to weep," is applied to a linear vertical mark below the eye, because it is here that tears trickle down. Generally the brand is highly conventional and unlike the object it represents, but in a few cases, though simplified, it retains all the essentials of the original, as, *e.g.*, the *rigl el ghorab*, a "crow's-foot," used by some of the negroid "Arabs" of the northern hills.

Rainfall Reservoirs and Water Supply. By Sir A. R. Binnie. Pp. xi + 157. (London: Constable and Co., Ltd., 1913.) Price 8*s.* 6*d.* net.

In the application of exact meteorological observations to practical life, the utilisation of rainfall records by the waterworks engineer takes a foremost place. Rainfall is moreover among the most important of the natural resources of a country, and it is fitting that Sir Alexander Binnie should put together the results of his wide experience in a book which will impress the townsman with this fact in its more direct association with his daily life, in addition to giving to the engineer a survey of the problem with which he is faced, and of the methods of dealing with it.

The first chapter treats of the measurement of rainfall and the variation in amount from year to year and place to place; diagrams are given to show how the total fall increases as the ground rises, and emphasis is laid upon the fact that in a region with a prevailing wind direction the maximum rainfall frequently occurs on the lee side of the high ground. Another diagram illustrates the approach of the average annual rainfall to a normal value as the number of years increases; thus one year may be 50 per cent. above or 40 per cent. below the normal, but the average of ten years is not likely to differ by more than 10 per cent. in either direction from the normal value.

The next chapter deals with the flow from the ground, floods, and evaporation, about which our knowledge is very deficient owing to the scarcity of trustworthy records. Subsequent chapters are devoted to the methods of calculating the available supply, the construction of reservoirs, and the arrangements for conveying the water from the source and distributing it to the users. There is much that is technical naturally in these chapters, but the subject is treated in such a way that even the details are made interesting, and their importance for safety or economy is clearly shown.

E. G.

Planetologia. By Ingegnere Emilio Cortese. Pp. vii + 387. (Milan: Ulrico Hoepli, 1913.) Price 3 lire.

In view of the fact that nearly 300 pages are taken up with terrestrial phenomena, and only eighty pages are devoted to the remaining members of the solar system, the title "Planetologia" scarcely seems suitable for the present book. Perhaps the author could not think of a more suitable title.

The book contains an exposition of some of the main physical properties of the earth's crust, the age of the earth, its past geological history, the theories of tides, earthquakes, volcanoes, the origin of the earth's atmosphere, and the principal physical features of the planets and moon. As a geologist the author claims to have formed definite views of his own on these questions, differing in many respects from commonly accepted theories; but, as he points out, it would be impossible for a writer to substantiate these varied theories unless he had travelled all over the world, besides being, at the same time, a mathematician, a physicist, a chemist, an astronomer, and a geologist. Considerable attention is given to theories of the displacement of the earth's axis.

A collection of theories of this kind, if thus propounded in a proper spirit, is not only interesting, but it opens up useful material for future discussion. On the other hand, not the least important feature is the insight which the book affords the general reader of known physical facts and phenomena connected with the earth and planets.

A Manual of School Hygiene. By Prof. E. W. Hope, E. A. Browne, and Prof. C. S. Sherrington. New and Revised Edition. Pp. xii + 311. (Cambridge University Press, 1913.) Price 4s. 6d.

The first edition of this manual, which was reviewed in our issue for August 15, 1901 (vol. lxiv., p. 373), was reprinted on three occasions before the appearance of the book in its present form. Six chapters on physiology by Prof. Sherrington have here been added. They aim at emphasising the salient portions of the subject, and deal with the body considered as a mechanism, the blood and its circulation, respiration, food and digestion, the temperature of the body, and muscle and nerve.

Library Cataloguing. By J. Henry Quinn. Pp. viii + 256. (London: Truslove and Hanson, Ltd., 1913.)

Mr. Quinn's book should prove of real service as a guide for young librarians to the various codes of cataloguing rules. His bright, helpful chapters should certainly convince the beginner in library work that the office of librarian is no sinecure; and the arrangement of his matter, and the subjects chosen for treatment, should enable information on practical cataloguing to be obtained with a minimum expenditure of trouble.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Energy in Planetary Motions.

If a particle of mass m be brought from infinity to distance r by the action of a central attraction varying as the inverse square of the distance, the potential energy exhausted in the process is $m\mu/r$, where μ is the "intensity of the centre." If the particle has experienced no resistance to its motion the kinetic energy is given by the equation

$$\tfrac{1}{2}mv^2 = m\frac{\mu}{r}.$$

But if the particle be made to move in a circle of radius r about the centre of force, the speed v is given by

$$v^2 = \frac{\mu}{r};$$

and the kinetic energy $\frac{1}{2}mv^2$ represents only half the potential energy exhausted. The other half must have been dissipated or disposed of in some way or other.

Similarly, if the particle be brought in from motion in a circle of radius r' about the centre to motion in the circle of radius r, so that potential energy of amount $m\mu(1/r - 1/r')$ is exhausted, the kinetic energy has been increased by only $\frac{1}{2}m\mu(1/r - 1/r')$, so that again only half of the potential energy exhausted is represented by the orbital motion, and the remainder has been expended in doing work against resistance of some sort. The central force has, in fact, done exactly twice as much work as that represented in the increase of the kinetic energy.

All this, of course, is perfectly elementary and well known, but it is nevertheless a curious dynamical fact that exactly half of the work done by the attraction must be expended in overcoming resistance.

I have not seen the corresponding theorem in elliptic motion anywhere explicitly stated. It is as follows:—*The time-average of the kinetic energy, taken for one revolution in the orbit, is half of the corresponding time-average of the potential energy exhausted in the passage from infinity to the distance r.* A similar theorem holds, of course, for the differences of energy concerned when the particle is transferred from one orbit to another about the same centre.

Let $2a$ be the length of the major axis of the elliptic orbit. The speed v at distance r from the centre is then given by

$$\tfrac{1}{2}v^2 = \mu\left(\frac{1}{r} - \frac{1}{2a}\right),$$

which, multiplied by m, is the equation of energy. The potential energy exhausted from infinity to distance r is again $m\mu/r$, and it can easily be shown that the time-average of the kinetic energy in the orbit is $m\mu/2a$.

Parenthetically, it may be remarked that this result is most easily and elegantly established by the following Newtonian process. If when r is the distance of the particle from the centre of force (one focus of the ellipse) r' be the distance from the other focus, and p, p' be the lengths of the perpendiculars from the foci on the line of motion at the instant, we have $r/r' = p/p'$, and, therefore, since $pp' = b^2$, where b is the length of the semi-minor axis, we have $r'/r = p'^2/b^2$. But the equation for v^2 can be written

$$v^2 = \frac{\mu}{a}\frac{2a - r}{r} = \frac{\mu}{a}\frac{r'}{r}.$$

Hence integrating for a period of revolution T we get

$$\int_0^T v^2 dt = \int v ds = \frac{1}{b}\sqrt{\frac{\mu}{a}}\int p' ds,$$

where ds is an element of the path, and the integrals with respect to s are taken once round the ellipse. Now, clearly $\int p' ds$ is twice the area of the ellipse—that is, $2\pi ab$. Thus

$$\tfrac{1}{2}m\int_0^T v^2 dt = \pi m\sqrt{\mu a}.$$

The period T is $2\pi\sqrt{a^3/\mu}$, and so the mean kinetic energy is

$$\frac{\pi m\sqrt{\mu a}}{2\pi\sqrt{\frac{a^3}{\mu}}}=m\frac{\mu}{2a}.$$

If we take the time-integral of both sides of the energy equation once round the path we get the theorem of elliptic motion stated above.

It may be remarked that $2m\pi\sqrt{\mu a}$ is the *action* for one revolution of the particle in its orbit, and thus we have the curious result (already known) that the action (and therefore the mean kinetic energy) for one complete revolution in an elliptic orbit is independent of the eccentricity. If the centre of force be shifted along the major axis, so that for different orbits about the centre of force the length of the major axis remains unaltered, the period and the action remain also unchanged.

It may be noticed that the process used above shows very clearly that the area traced out by the radius vector from the "empty focus" is proportional to the *action*, for the time given by the corresponding area traced out by the radius vector from the centre of force. I observed this fact some years ago, but found that it had previously been put on record by Tait.

For a hyperbolic path round the centre of attraction the energy equation is

$$\tfrac{1}{2}mv^2=m\mu\left(\frac{1}{r}+\frac{1}{2a}\right),$$

where $2a$ is the distance between the vertices of the two branches of the hyperbola; and we see that in this case the kinetic energy at distance r *exceeds* the potential energy exhausted in the transference from infinity to that distance by the mean kinetic energy of the motion in an ellipse of semi-major axis a. Thus if a planet formed in the course of the condensation of a nebula is to have a hyperbolic orbit, it must, by an explosion of chemical energy, or by some other convulsion or process, have a quantity of kinetic energy given to it, in excess of that produced by the transference of the matter from infinite dispersion in space. In the evolution of planets according to the nebular hypothesis hyperbolic orbits would thus be exceptional cases.

It may be noted that in a certain sense $m\mu/2a$ is also the mean kinetic energy in the hyperbolic orbit. For, when r has become considerable, $\frac{1}{2}mv^2$ is sensibly equal to $m\mu/2a$, and the time for this sensibly constant value is infinite.

A. GRAY.

Boat of Garten, July 23.

"Phosphorescence" of Pennatulida.

PROF. NEWSTEAD and I have had two of the few British Pennatulida—*Pennatula phosphorea* and *Funiculina quadrangularis*—"phosphorescing" to-day before our eyes, so it may be worth recording the impressions while they are fresh. *Pennatula phosphorea*, as its name indicates, has long been known to emit light, and, writing from memory, I think Sir Wyville Thomson, in his "Depths of the Sea," refers to the "lilac phosphorescence of Pavonaria" (=Funiculina). Prof. Newstead and I have just seen the colour and distribution of the light very clearly in a makeshift dark-room (the lazarette of the yacht), and also on the deck at midnight. In Funiculina the distribution of the luminosity is very curious and quite different from that of Pennatula. There are many distinct sparkles over the polype-bearing part of the colony (corresponding, no doubt, to the individual polypes), but the long, bare lower part of the stem, 9 in. to a foot in length, when gently stroked in the dark glows with a continuous sheet of light of (it seems to me) a pale-green colour which flickers or pulsates like a lambent flame. The light on this bare part of the colony is certainly more intense than that of the polypes, and is the most brilliant "phosphorescence" I have seen in any marine animal. I have not seen Pyrosoma alive, but I imagine from the descriptions it may be even more brilliant than Funiculina.

In Pennatula, on the other hand, the light appears to be restricted to the polypes. I have not been able to excite any luminosity in the stem portion of the colony, but the illumination of the polypes is very general and beautiful—more general and more lasting than the sparkles that the polypes give in Funiculina.

Prof. Hickson, in a letter just received, asks me, if possible, to observe the phosphorescence of the other British Pennatulid, *Virgularia mirabilis*. I have not yet succeeded in dredging Virgularia here, but it ought to be found in these waters, and probably when examined alive in the dark will show some degree of phosphorescence like its two relations referred to above.

We have been able to get detailed colour notes of the living Funiculina, and some photographs of polypes extended to nearly an inch in length, which we hope may be useful.

W. A. HERDMAN.

S.Y. *Runa*, Loch Sunart, N.B., July 26.

A Red-water Phenomenon due to Euglena.

A VERY remarkable red-water phenomenon is at present observable in a small pond in Broad Oak Park, Worsley, near Manchester, just in front of the seventh tee on the golf course. The surface of the pond—at any rate at times—is covered in places with an almost blood-red scum, which seems to float on the surface film like fine dust. The scum sometimes assumes a greenish hue. Microscopical examination shows that it is due to the presence of immense numbers of a large species of Euglena, the green chlorophyll of which, as in the case of Hæmatococcus, is more or less replaced by red hæmatochrome.

On keeping some of the water and scum under observation in a soup-plate, it is seen that the organism occurs chiefly in two conditions—crawling on the bottom in an elongated form, and resting on the surface in a spherical form. It does not seem to swim freely about in the intermediate zone of water, so that the red colour is confined to the bottom and the surface, and not, as in the case of the active form of Hæmatococcus, dispersed through the water itself. Crawling seems to be effected by typical "Euglenoid" contractions, but a very long flagellum is sometimes visible at the anterior end, while the posterior extremity is formed by a sharp projection free from pigment.

Since writing the above I have been able to observe how the Euglenæ reach the surface of the water. They evidently secrete some sort of slime in which they become entangled. Bubbles of oxygen gas, given off by the Euglenæ in presence of sunlight, are also caught in this slime, and when these reach a certain size they rise to the surface, trailing strings of slime, with numerous entangled Euglenæ, after them.

ARTHUR DENDY.

University of London, King's College, July 30.

The Terrestrial Distribution of the Radio-elements.

IN my letter of June 19 I briefly outlined three arguments which consistently point to a concentration of the radio-active elements in the earth's crust, such concentration having been accomplished at the expense of the material of the interior. The first of these arguments (in which the limited distribution of the radio-elements is deduced from the earth's temperature-gradient) is made the basis of a revival of Arrhenius's view that radio-active disintegration may be inhibited under the conditions prevailing at great depths (NATURE, June 26, July 10, and July 17). Thus, in place of the deduction that the amounts of uranium and thorium existing in the earth's interior are negligible, even thermally negligible, is put forward the alternative deduction that these parent elements are not necessarily absent, but only temporarily impotent, their output of energy, by which alone we could be aware of them, being inhibited by the enormous pressures to which they are subjected.

The latter alternative is favoured by the philosophic conception embodied in Le Chatelier's law of reaction, viz. that the internal reactions within a material system are such as will tend to oppose any external influences by which its equilibrium may be disturbed. It would at once be deduced from this "law" that radio-active transformations, implying as they do an immense output of energy in the form of electronic and atomic bombardments, must be inhibited by the application of sufficiently high pressure and temperature. Under high pressures the internal reactions will tend to oppose the pressure and therefore an increase of volume, and similarly under high temperatures the internal reactions will tend against a further rise of temperature. The internal reaction is favoured which results in the absorption of energy from an external source. Hence, radio-active changes, involving increase of volume and rise of temperature, would presumably be opposed by the physical conditions of the earth's deep interior.

As yet, however, we are unable to assert whether this deduction may safely be made to the extent of assuming inhibition. Frankly, it is a step taken in the dark. The law of reaction is known to be a useful guide as regards the tendency of molecular activities; its extension to include the internal activities of atoms has yet to be demonstrated. The evidence from direct experiment is manifestly insufficient, but so far as it goes it betrays on the part of the radio-elements an astonishing disregard for all external influences. For the present, then, the problem stands unsolved, as indeed it must remain until we know more of the internal mechanism of the radio-active atom.

However, whether one favours radio-active inhibition or independence, the remaining arguments in support of a crustal concentration of radium stand unaffected. The highest concentration of the radio-elements is found in the acid rocks, which contain six times as much radium as the ultra-basic rocks. That is to say, the lighter rocks in their capacity as solvents are capable of carrying a higher proportion of the radio-elements than are the heavier rocks. It is for this reason that uranium, which is the heaviest element of all, has not gravitated to the earth's metallic core, as Dr. Schiller considers would be most probable. Further, there is clearly a marked antipathy between the radio-elements and native iron, for in all the terrestrial examples of the latter which have been examined, uranium and thorium are barely detectable. Correlating these facts with the earth's trizonal structure, we should expect an internal metallic core free, or nearly so, from the radio-elements, an intermediate zone originally poor in, and now almost devoid of, these elements, and an outer crust more richly endowed, its wealth of radium, like its wealth of silica (and perhaps of many of the metallic ores), having accumulated in the course of the earth's evolution at the expense of the more sparsely distributed internal stores.

On the parallel drawn by Daubrée and extended by Suess between iron meteorites and the earth's metallic core and between stony meteorites and the earth's intermediate ultra-basic zone, this conception receives still more convincing evidence. The stony meteorites are even more poverty-stricken in radium than the ultra-basic rocks, and the iron meteorites contain no radium whatever.

ARTHUR HOLMES.

Imperial College, London, S.W., July 18.

Area of Earth's Surface Visible at any Altitude.

IN these days of aviators and of record heights attained by them, perhaps the following rule to find the area of the earth's surface visible from a given height may be of interest. The rule depends upon the fact that if the height above a sphere is $\frac{1}{x}$th part of the sphere's diameter, then the area visible from this height is $\frac{1}{x+2}$th part of the sphere's total area. This admits of an easy geometrical proof.

Rule.—Express the height above the earth's surface as a fraction of the earth's diameter; multiply the numerator of this fraction by 2, and add the result to the denominator, then the resulting fraction gives the fraction of the earth's surface visible.

Examples.

Height above earth's surface	Height expressed as a fraction of earth's diameter	Fraction of earth's total surface visible
24,000 miles	$\frac{3}{1}$	$\frac{3}{7}$
8,000 ,, ...	$\frac{1}{1}$	$\frac{1}{3}$
70 ,, ...	$\frac{7}{800}$	$\frac{7}{814}$
1 mile	$\frac{1}{8000}$	$\frac{1}{8002}$
506·881 in.	$\frac{1}{999998}$	$\frac{1}{10^6}$
42·24 ft.	$\frac{1}{10^6}$	$\frac{1}{10^6+2}$
At the moon (240,000 miles)	$\frac{30}{1}$	$\frac{30}{61}$

Of course, the effects of refraction are neglected; otherwise the rule is strictly accurate.

W. MOSS.

Municipal Secondary School, Bolton.

Submerged Valleys and Barrier Reefs.

As I have never visited the Pacific Islands, I do not attempt to bring their valleys under the same category as those of the coast of the Red Sea and East Africa. Darwin's theory having been so often held to apply to all barrier reefs, it seemed to me interesting to refer to cases to which that theory does not apply, though superficially resembling that cited by Prof. Davis (NATURE, February 6 and June 26).

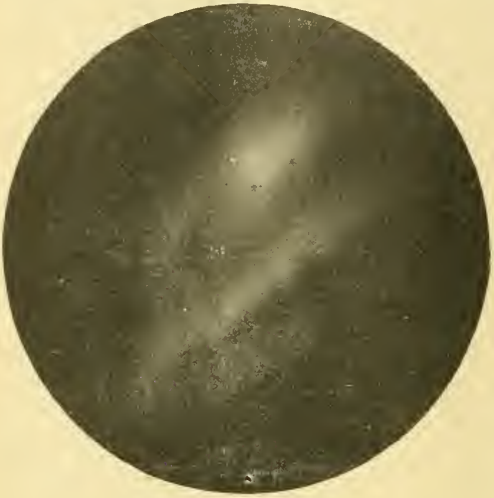
I wished also to emphasise the resemblance between fault and subaërial erosion valleys, and in spite of Prof. Davis's assertion that they can be distinguished readily I think we need definite assurance that those he cites are without doubt of the latter kind. Given that assurance, Dana's proof of Darwin's theory holds true for that case, but not universally wherever barriers (and atolls) are found. I myself took it for granted that those of Pemba and British East Africa were due to erosion by streams and tides alone, until I compared the better preserved examples of this almost rainless climate.

CYRIL CROSSLAND.

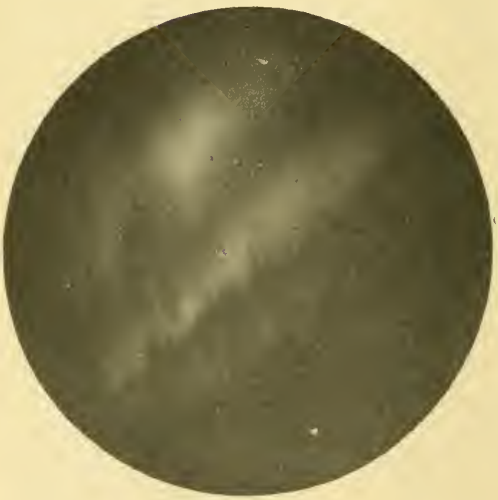
Dongonab, Red Sea, July 12.

PHOTOGRAPHS OF THE AURORA.

AN important advance in the knowledge of the aurora is the outcome of the spring expedition to Bossekop, under M. Carl Störmer. This expedition was undertaken to complete the work done in the 1910 expedition, which was so fruitful of results. The experience gained on the first occasion has been most successfully utilised, and M. Carl Störmer has recently but very briefly communicated an account of the research to the Paris Academy (*Comptes rendus*, June 16).



Bossekop.



Korsnes.

Fig. 1.—Photograph of the same aurora taken on March 3, 1913, at 10h. 36m., Central European time, from Bossekop and Korsnes.

From February 28 to April 1 of the present year the expedition secured 636 pairs of simultaneous photographs of the aurora at the two stations, namely, Bossekop and Store Korsnes, the latter station being about 27 kilometres to the north of Bossekop. Of these photographs 450 pairs are stated to be very satisfactory and furnish material sufficient to compute with a large degree of accuracy the form, position, and altitude of all the principal kinds of aurora borealis.

Further, exactly at the same time as the photographs of the aurora were taken, other photographs, with a prismatic camera, were secured. On these latter photographs can be seen not only the spectra of the stars, but several superposed impressions of the auroræ corresponding to different spectrum lines.

As in 1910, a kinematograph was employed to try to secure the changing phases of the aurora: for the most part the auroral images were too faint. On three occasions, how-

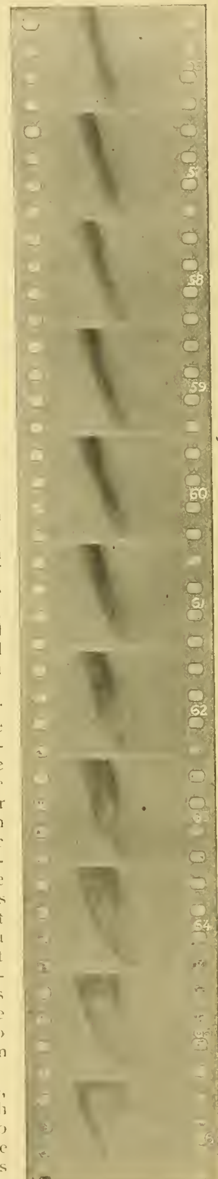


Fig. 2.—Kinematographs of Aurora.

ever, when the auroræ were very bright, consecutive exposures were given, lasting from 0·5 second to 1 second for each image.

Another series of about 100 photographs was taken on April 8 with the kinematograph, each exposure lasting about four seconds. These photographs demonstrate the great utility of this instrument not only in obtaining consecutive features of the displays, but in securing ordinary photographs at the two stations. The communication is accompanied by two most interesting plates. The first of these shows excellent reproductions of the aurora on March 3, photographed at the two stations at the same time, with clear impressions of the stars, demonstrating at a glance the parallactic effect (Fig 1). The second plate reproduces four portions of the kinematograph strip exposed on April 8 at Bossekop. These speak for themselves in indicating the valuable aid the kinematograph brings to auroral studies. A portion of these strips is here reproduced, the exposures for each portion being four seconds (Fig. 2). The gradual change in form and density of the filaments illustrated is here clearly indicated. M. Störmer states that the results of this expedition will be published in considerable detail in a subsequent memoir, and the above brief summary is sufficient to show that the memoir will be a most valuable contribution to our knowledge of the aurora.

THE INTERNATIONAL MEDICAL CONGRESS.

THE International Medical Congress, which is now meeting in London, may fairly be described as the greatest scientific congress ever held in the metropolis; for the time has gone for ever when a medical congress can be confined to the sciences commonly thought of as medical, and it is probable that the future will remember with most gratitude those contributions to the present congress which may seem to have the least relation to medicine.

No single fact marks better the advance of medical thought since last the congress met in London, thirty-two years ago, than the delivery of an address by Mr. W. Bateson on heredity. The supreme names of the past may have no living parallels, but their work bears fruit. Pasteur is gone, but the bacteriologists are all in force at the congress, and his pupil Laveran, who discovered the parasite of malaria a generation ago, is here to see, at any rate in tropical medicine, something like the realisation of his master's *dictum* that "it is in the power of man to make all parasitic diseases disappear from the earth." Lister is not here, but Prof. Cushing can scarcely fail to refer to the surgery of the pituitary body, which seemed wildly impossible only a few years ago. Jonathan Hutchinson is not here, but Prof. Ehrlich will report on the modern treatment of syphilis, though Schaudinn, who found the spirochæte, did not live to hear of salvarsan.

The congress will greatly serve science, but it may still more greatly serve public opinion, and even develop something like public wisdom in some respects. The international resolution on the value of vivisection will be an illustration of this, and also the discussion on alcohol and degeneracy; but most may be hoped from the discussion, in the Albert Hall itself, of the duty of the State in respect of syphilis. This can scarcely fail to reinforce the demand for a Royal Commission lately made by the leaders of medicine in this country, supported by the British Medical Association at Brighton, and repeated by the English-Speaking Conference on Infant Mortality in London on Tuesday, on behalf of absolute innocence, now commonly murdered by our immoral neglect of this subject.

THE RIVERS OF THE SCOTTISH LOWLANDS.[1]

THE handsome volume before us is about evenly divided between the physiographic and industrial questions of the Forth area, and in this combination of interests serves to remind us of the enormous scope of modern geography.

Mr. Cadell has qualified himself to be the historian of the Forth by a long period of service in the Geological Survey of Scotland; and for the subjects treated in the latter half of the book by an almost equally long period of public service in the Lothians.

The history of the Forth begins naturally with the origin of the solid rocks which form the floor of its valley. These foundation-stones were laid in the far-off times of the Old Red Sandstone lakes and the steamy swamps of the Carboniferous. In the first three chapters an excellent light treatment of the many points of interest in connection with the deposition of these rocks, especially the economic materials they contain, is given. After the formation of this basement there must have been a long period of peneplanation, then submergence, and finally re-emergence of the peneplane with a slight tilt *en bloc* to the east. This tilt determined the direction of the Forth and other consequent rivers.

The most original and interesting portion of the book, perhaps, is that which deals with the development of the river system. The Forth, however, cannot be treated in this respect as a separate entity. Its origin involves that of the Clyde and Tweed, and also the lochs of Dumbartonshire and Argyllshire. The Forth originally rose in the highlands of the latter counties, but its headwaters were captured by an energetic stream which flowed southward down what is now the Firth of Clyde. The well-marked narrow trench crossing the Midland Valley from Clydebank to Grangemouth is now occupied by small streams totally disproportionate to its size, and is regarded by Mr. Cadell as the course of a former large tributary of the Forth. The Clyde

[1] "The Story of the Forth." By H. M. Cadell. Pp. xvii+299+plates (Glasgow: James Maclehose and Sons, 1913.) Price 16s. net.

system has thus been formed largely at the expense of the Forth, and in its later depredations has also appropriated part of the Tweed. It has been favoured by the comparatively soft rock-material along its earlier course, by its steeper gradient, but most perhaps, by the more copious rainfall of the western mountains.

The subsequent Glacial period, although causing considerable modification in detail, has not altered the essential features of the topography developed by the rivers. Neither has the submergence which has drowned the seaward parts of the Clyde and Forth valleys, and transformed the Clyde system especially into a series of sea-lochs, availed to obscure the ancient lines of the drainage-system, of which Mr. Cadell has given such a luminous explanation.

Much scattered information on related physiographic subjects, such as the buried channels of the Forth valley and the old lochs of the Edinburgh district, is brought together for the first time in this book.

The latter half of the book deals with industrial subjects connected with the Forth valley. The famous Carron Company and the rise of the Scottish iron industry are treated in chapters ix. and x., and we are reminded how great a part the Cadell family took in the establishment of this great concern in the latter half of the eighteenth century. We also note that Mr. William Cadell, after leaving the Carron Company, interested himself in the establishment of the Clyde Ironworks at Old Monkland, near Glasgow, and thus helped to lay the foundations of the iron-smelting industry in the west of Scotland.

The final chapters deal with land reclamation in the Forth valley, and a very interesting account of an old labour colony is given. This was established by Lord Kames in 1766 for the clearing of Blairdrummond Moss, a work which turned a quaking bog into a fertile plain that now supports scores of families. These later chapters are most interesting and readable, although garnished here and there with obsolescent economics. The book is finely printed, and is a pleasure to read and handle. It is illustrated by many excellent plates and maps.

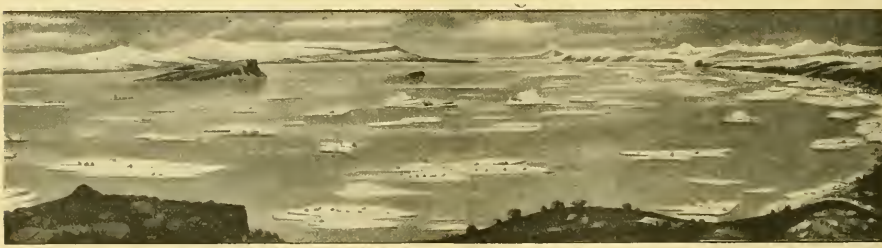


Fig. 1.—Scene at the end of the Ice age when the valley was submerged under an icy sea.

Fig. 2.—The modern landscape after the sea had retreated to its present level.
Panoramas from the Craig at Stirling at different periods in the history of the earth. From "The Story of the Forth."

THE IMPROVEMENT OF INDIAN WHEAT.[1]

NOWADAYS, when the English miller regards Indian wheat as a valuable addition to his resources, the work of the authors of this memoir in improving it is of the utmost national importance. The progress they have made already deserves to be widely known and commended. The problem is the same as that which confronts us in this country, where, however, the farmers still refuse even to try to understand it—namely,

[1] Memoirs of the Department of Agriculture in India, vol. v., No. 2. By A. Howard, H. M. Leake, and G. L. C. Howard, Agricultural Research Institute, Pusa.

the introduction of a strain of wheat, of easy cultivation, which will combine high yield with quality and give a satisfactory straw. Usually in India, as elsewhere, the consistency of a wheat varies greatly, according to the conditions under which it is grown. Although weak wheats can be improved to some extent in milling and baking qualities by cultivation, they have not been made to behave like strong wheats. Owing to the shortness of the growth-period and the liability of the water-supply to deficiency, moderate-yielding wheats are on the average the most profitable to the grower. The Pusa experiments, which have been in progress since 1907, show that the strong wheats with good milling properties retain these properties both under canal irrigation and on the black soils, and that high yield and high quality can be combined in the same wheat.

Such adverse factors as waterlogging and late cultivation affect both the yield and quality of the wheat, and the ryot requires training to the fact that rice conditions of drainage will not do for wheat cultivation. As elsewhere, the greatest financial return for the labour is obtained by growing to perfection a wheat which combines yield with quality.

We believe that the type of wheat preferred by the natives for their home consumption is altogether different from the strong wheat so desired for the export market: the authors ignore this point, but it would appear undesirable to sacrifice the home to the export market for the sake of such an elusive quality as strength.

E. F. A.

PROF. JOHN MILNE, F.R.S.

To few men is it given to follow the growth of a new science from its infancy to maturity, and to still fewer to be prime movers in bringing about such a development. Nevertheless this is the claim we can confidently make for Dr. John Milne. He found seismology in its embryo stage, as left by the pioneer Robert Mallet—with its instruments of the most unsatisfactory type, its observational methods of the crudest description, and its inferences far from conclusive—but he lived to see well-equipped seismographical observatories scattered all over the globe, seismological societies established in every civilised State, and the science of seismology universally recognised as an important and highly suggestive branch of geophysics. And it was undoubtedly to Milne's genius and energy that the impulse leading to these results has been largely due. Yet he had not reached the age of sixty-three when he died on July 31, and his earthquake studies were comprised within a period of thirty-five years!

The two halves of this period of incessant activity had each its particular outlook—the first mainly confined to earthquake-shaken Japan; the second extending to the whole globe. At the early age of twenty-five, Milne, a student from the Royal School of Mines, with a short experience in Newfoundland, Labrador, and Arabia, was appointed Professor of Geology and Mining in the University of Tokyo. Active as the young professor was in his teaching work, writing text-books on crystallography and mining, and conducting expeditions to study the volcanic and other phenomena of Japan and neighbouring lands, it was, nevertheless, outside his official duties that he began to find the fullest scope for his superabundant energies.

It was the frequent earthshakings of his adopted country that supplied food to Milne's inquiring and speculative mind. Before he was thirty he had founded the Seismological Society of Japan, and a seismological journal; but for the first ten years at least Milne might have truthfully asserted, "I am the Seismological Society, and I *write*, as well as *edit*, the journal." He established observing stations all over Japan, eventually reaching nearly 1000 in number, each of which was supplied with a register in the form of a cheque-book, and the "cheques," filled up with answers to questions in Japanese and English, when posted to Milne, supplied him with the means of drawing "isoseismal" lines on his maps for each shock. But this laborious task, with earthquakes of almost daily occurrence, was only a small part of his work. He invented and improved various forms of recording instruments, investigated the laws of transmission of vibrations through the earth's crust by "artificial earthquakes," studied the principles on which buildings that should be "earthquake-proof" may be constructed, registered the meteorological conditions under which earthquakes occur, and perseveringly followed innumerable clues in diverse directions that continually suggested themselves to his ever-open mind.

Not the least important part of his work was the training a band of native observers, who are ably continuing and extending Milne's investigations in Japan. More than one hundred memoirs, filling more than two-thirds of the nineteen volumes of the Transactions and Journal of the Seismological Society of Japan, constitute the best evidence of Milne's devotion to the science during his seventeen years of residence in the country.

But Milne's retirement from the Japanese professorship at the age of forty-five furnished the opportunity for entering on a wider sphere of labour—one to which he was able to devote the whole of his time and effort. Just before starting for England, however, a most disastrous fire destroyed his accumulated books and instruments—the most serious loss being that of the stock of precious volumes of the Transactions and Journal of his society.

Undismayed by this misfortune, Milne, within three weeks of his arrival at home, had built a brick pillar at Shide, in the Isle of Wight, and set up on it his seismographs. The site of this now famous observing station had been selected from its proximity to a line of great earth-movements during a late geological period. Established at this centre, he entered upon the task of enlisting the aid of Government departments, public institutions, and private individuals to his great work. Before he died he had the satisfaction of having forty observing stations, all furnished with his own type of seismometer, in constant correspondence with him. The careful tabulation and discussion of the records from these observatories had occupied him during the last seventeen years, and the results have been given to the world in a series of circulars and reports by the British Association, the society which, so far as its means have allowed, has constantly subsidised and published Milne's work; in later years the Royal Society has extended its powerful support to him.

To readers of NATURE it is not necessary to enlarge on the results of Milne's labours since his return to England. His important work in tracing the cause of the fracture of submarine cables; his determination of the sites of distant earthquakes from seismographic records; his proof of the distinction between vibrations that travel *through* the earth, and those going *round* it; and many other suggestive contributions, are familiar to everyone.

No more striking proof of Milne's remarkable activity can be afforded than the fact that while the British Association has, since the year 1841, published fifty-three reports on seismology, in which 562 communications are embodied, no fewer than 463 of these are from the pen of Milne! And all are in addition to his books and numerous articles in scientific and other journals.

The eighteenth (alas! it is the last!) of the luminous reports prepared since his return to England is now in the press, and will be presented at the forthcoming meeting of the British Association. It fittingly concludes with a touching and generous obituary notice of his Japanese assistant, Shinobu Hirota (the faithful "Snow"), who returned home to die last April. But, indeed, Milne's was an ever-generous soul. Students of seismology from all lands visited Shide, and were always warmly welcomed by Milne, often partaking of his hospitality. Not only these, but idle tourists, journalists in search of "copy," teachers with their pupils, and even children, were ungrudgingly received. In spite of his exacting labours, he seemed ever ready to show his instruments and talk about his work with the most casual visitor.

Some, perhaps, may suggest that Milne was wanting in sympathy with the work of co-ordinating the results of other organisations than his own; and it may be admitted that his Pegasus did not run well in harness. But it must be remembered how, from the first, he had been accustomed to bear all the weight and responsibility of great enterprises on his own broad shoulders. John Milne's death is indeed a great calamity for science—how great will only be realised when the attempt is made to supply his place.

J. W. J.

NOTES.

THE Baly medal has been awarded by the Royal College of Physicians to Dr. J. S. Haldane, F.R.S., reader in physiology at the University of Oxford, in recognition of his distinguished contributions to physiological science.

PROF. W. C. McINTOSH, F.R.S., professor of natural history in the University of St. Andrews, and director of the Gatty Marine Laboratory, has been elected president of the Ray Society in succession to the late Lord Avebury.

THE death is announced of Mr. T. H. Russell, of Birmingham, who was a fellow of the Linnean Society and the author of a work on mosses and liverworts.

A PARAGRAPH in *The Times* of August 2 states that there are 106 clocks attached to premises in the City of London, and observable from the public way. Of these, forty-two are synchronised from Greenwich Observatory. There are, in addition, twenty-nine church clocks in the City (including St. Paul's Cathedral), none of which are synchronised or even unanimous in their irregularity.

IN a letter published in *The Scotsman* of July 24, Dr. John G. Havelock, of Montrose, describes some observations which have led him to conclude that common varieties of the single petunia are true insectivorous plants. Mr. Alex. Johnstone, of the same town, has sent us an account of observations of his own which suggest the same conclusion. Sir Herbert Maxwell, in *The Scotsman* of July 28, thinks *Rhododendron barbabum* also deserves attention as probably an insectivorous plant. Only a careful experiment can determine the accuracy of the suggestion that Petunia is insectivorous, and it may be hoped the point will receive the attention of plant physiologists.

THE exhibited collection of Mesozoic crocodiles in the Geological Department of the British Museum (Natural History) has just been rearranged to incorporate some important recent acquisitions. A new specimen of Mystriosaurus from the Upper Lias of Würtemberg, prepared by Mr. B. Hauff, is one of the finest known examples, with almost complete limbs. The stomach-contents are seen, mingled with swallowed pebbles. A specimen of Geosaurus, from the Lithographic Stone of Bavaria, shows for the first time the triangular tail-fin by which this essentially marine crocodile propelled itself. The unique example of the Wealden river-crocodile Goniopholis, discovered a few years ago by Mr. R. W. Hooley in the cliff near Atherfield, Isle of Wight, and described by him in the Geological Society's Journal, has also been mounted and exhibited.

THE sixtieth birthday of Prof. W. Ridgway was fittingly commemorated a few days ago by a dinner at Caius College, Cambridge, attended by scholars and men of science from all parts of the kingdom. Few archæologists of the present day have done more, by original work, stimulating instruction, and the application of anthropological methods in the solution of historical problems, to advance English scholarship. His treatises "The Origin of Currency and Weight Standards," "The Origin and Influence of the Thoroughbred Horse," and "The Origin of Tragedy," have advanced our knowledge of prehistoric archæology, while his separation of the northern and southern elements in early Greek history, received at first with almost generally hostile criticism, has passed into the region of orthodox commonplace in the light of the Cretan discoveries by Sir A. Evans. It is much to be desired that the completion of his admirable work, "The Early Age of Greece," will not be much longer delayed.

The death is announced, in his sixty-sixth year, of Sir Richard Powell Cooper, a distinguished agriculturist, who played a very large part indeed in developing the enormous industry in exporting pedigree live-stock, which has now become a recognised part of British agriculture. He was also a member of the firm of Cooper and Nephews, chemical manufacturers and exporters of live-stock; this firm set up laboratories at Watford and Berkhamsted, and made chemical preparations for agricultural and horticultural purposes, and also conducted a number of investigations bearing on these substances. Sir Richard farmed a large estate at Shenstone Court, Lichfield, and he also owned land and live-stock in Australia, the Argentine, South Africa, Paraguay, Russia, and elsewhere. He was an exceedingly good business man, and introduced business methods into branches of agriculture and horticulture where such methods had previously been wanting. In particular he played a great part in revivifying the Royal Agricultural Society, when a few years ago it came dangerously near to collapse.

As the white man spreads over the tropical regions of the earth, he comes continually into contact with new and unfamiliar forms of disease, often of a deadly kind. One of the most recent additions to the white man's burden is a peculiar malady known as Verruga (or Verruca) Peruana, also as Fiebre de la Oroya, or Carrion's fever, described by Darling as "an infectious disease in which a fever of irregular type, associated with more or less severe anæmia, is followed by a wart-like eruption of the skin, and sometimes of the mucous or serous membrane." Two forms of the disease are recognised, malignant and benign. It occurs in certain valleys on the western slopes of the Peruvian Andes at altitudes of from 1000 to 12,000 ft., most often between 2000 and 6000 ft. According to the researches of Mayer, Rocha-Lima, and Werner (*vide* Tropical Diseases Bulletin, No. 12, p. 727), the parasitic cause of the disease is one of the problematic class of organisms known as Chlamydozoa. In a recent letter to *The Times* (July 12) Dr. Anderson states that, according to a telegram from Mr. Billinghurst, President of the Peruvian Republic, it has been discovered by Prof. Townsend, of Lima, that verruga is transmitted by one of the small blood-sucking midges of the genus Phlebotomus. These insects are small, hairy, moth-like flies, widely distributed in tropical or subtropical regions; one species is known to transmit "Papataci fever" in Dalmatia, and by some authorities the dissemination of Oriental sore is also attributed to midges of this genus.

Mr. W. M. Newton has republished from the Journal of the British Archæological Association for last March an important paper entitled "Palæolithic Figures of Flint Found in the Old River Alluvia of England and France, and called Figure Stones." These are nodules of flint assuming the shapes of animals or of animals' heads. These objects were discussed by Boucher de Perthes in his "Antiquités Celtiques et Antédiluviennes," published in 1840, and by the late Sir John Evans in *Archaeologia*, vol. xxxviii., 1860, the latter eminent authority regarding them as "the effects of accidental concretions and the peculiar colourings and fracture of flint, rather than as designedly fashioned." Mr. Newton has, in recent years, found similar objects in a gravel-pit at Dartford, Kent. In the present paper he describes his fine collection, and suggests their analogy with specimens found in Egypt and elsewhere. The full materials and fine illustrations supplied will enable archæologists to study the facts, which are certainly striking. Meanwhile, the conclusions of Sir John Evans do not appear to be materially affected by the fresh evidence now presented.

A remarkable group of long-snouted representatives of the Lower Tertiary perissodactyle family Titanotheriidæ, from the Uinta beds of Utah, forms the subject of a paper by Mr. E. S. Riggs in the Geological Publications (vol. iv., No. 2) of the Field Museum, Chicago. Four generic types (one of which, Rhadinorhinus, is described as new) are recognised in this group, collectively forming the subfamily Dolichorhinæ.

It is well known to poultry-breeders that birds produced by crossing white Leghorns with black or dark-coloured breeds frequently exhibit a barred plumage ("cuckoo-marking"), of which there is no trace in either of the parent stocks. As the result of experiments, Dr. P. B. Hadley is enabled to demonstrate, in the July number of *The American Naturalist*, that this barring occurs in a certain proportion of such cross-bred birds of the F_2 and subsequent generations, and that the pattern is derived from the white stock. The result of the experiments has, however, no bearing on the ultimate origin of this type of marking, but merely indicates the existence in white Leghorns of factors tending to produce both black and barring.

According to an illustrated article by Prof. C. L. Edwards, in the June number of *The Popular Science Monthly*, "abalones," as the various species of Haliotis are locally called, are extensively fished in California, both as a food-supply and for the sake of their shells, which form an important source of mother-of-pearl, and, when polished, are also used as ornaments and as shades for electric lights. A considerable number of pearls are also yielded by abalones. The price of the shells ranges from 1000 to 4000 dollars per ton, and the total value of the shells and flesh taken at Long Beach alone during the year ending in July, 1912, was no less than 95,800 dollars.

To part 4 of the first volume of *Mitteilungen landwirtschaft. Lehrkanzeln k.k. Hochschule für Boden-*

kultur (Vienna, 1913), Dr. Paul Saborsky contributes an exhaustive and well-illustrated account of Welsh black cattle, in which their characteristic features, corporeal measurements, osteology, and etiology are dealt with in detail. The author fully endorses the opinion that these cattle are nearly related to the extinct black aurochs (*Bos taurus primigenius*) on one hand, and to the white British park-cattle on the other, such resemblances as they display to the Celtic shorthorn (*B. longifrons* or *brachyceros*) being, perhaps, inherited from a local race of the aurochs. It is to be regretted that as the memoir is written in German it is not likely to be widely read in this country.

According to the report for 1912 the Field Museum of Natural History, Chicago, continues to make rapid progress, both in the matter of adding to its scientific collections, and in the installation of realistic exhibits in the public galleries and halls. The report is illustrated with photographs of several of these

Sonoran grizzly bears in the Field Museum, Chicago.

striking exhibits, including a group of grizzly bears in a forest and a colony of beavers on a dam in one of the great rivers; in all of these the foreground is occupied by the animals themselves, mounted with their natural inanimate surroundings, while the background is artistically painted.

During a visit to a whaling station in the Faröes in the summer of 1911, Dr. L. Freund had the opportunity of studying portions of the anatomy of several species of whales, and has published the results of his investigations in the issue for November and December, 1912, of the *Sitzungsberichte* of the Vienna Academy of Sciences. It may be recalled that a short time ago reference was made in Nature to Mr. T. B. Goodall's opinion with regard to the homology of the whalebone plates of the whalebone whales. According to Dr. Freund, this opinion is by no means new, but was long since adopted by Eschricht, who contended, in opposition to current views, that the plates do not represent the palatal rugæ of land animals. If we understand him rightly, Dr. Freund appears inclined to support this interpretation, although he points out that there are considerable differences in the structural arrangement of the plates in different groups of whalebone whales. Other items in cetacean anatomy are also discussed in the paper, which likewise contains a section on the genitalia of the porpoise.

We have received from the Government Printing Office, Calcutta, a series of extremely useful notes on Indian timbers (Forest Bulletins Nos. 16 to 21, price 4*d.* each). The timbers dealt with are *Gmelina arborea*, *Pterocarpus marsupium*, *Terminalia tomentosa*, *Lagerstroemia lanceolata*, *Ougeinia dalbergoides*, and *Anogeissus latifolia*. Each of these bulletins gives the distribution, locality, and habit of the tree, properties and uses of the timber, minor products, if any, natural reproduction and rate of growth, and other information, and includes a specimen of the wood in the form of a thin section mounted in a stout cardboard frame. These bulletins form part of a series of notes on the lesser-known Indian timbers, compiled by officers of the Forest Research Institute, Dehra Dun, and it is announced that on application to the forest economist specimens of any timber will be supplied free, and inquirers put in communication with local forest officers.

As a result of much recent work on the effect of various metal salts on plant growth in water culture, pot culture, and in the field, the possible value of manganese salts as fertilisers is discussed in a leaflet published by the U.S. Bureau of Soils, Circular No. 75. Beneficial effects have been observed in the cultivation of numerous crops, and in many cases the increase has been very appreciable—upwards of 25 to 30 per cent. Its effect in soils is attributed partly to a direct action on the soil constituents, partly to an acceleration of enzymic changes in the plant, and also to the stimulation of micro-organisms in the soil. It has further been found that manganese increases the absorption of other ingredients by the plant, particularly lime and magnesia. For experimental work and as a complementary fertiliser to sodium nitrate, phosphates, potash, and lime, the use of soluble manganese salts in quantities not greater than 100 lb. per acre is recommended.

In connection with the movement for the conservation of natural resources in the United States, an investigation has been made into the occurrence of potash salts in such amounts as to warrant their extraction on a commercial scale (U.S. Bureau of Soils, Bulletin 94). In no case has an artificial or natural (subterranean) salt been found suitable for further extraction, but the bitterns derived from the manufacture of salt from sea-water contain potassium in such amounts as to make it probable that they could be evaporated to make valuable manure salts. In addition to this, the brine of one desiccated lake of southern California has been found to contain sufficient potash to make it a possible commercial source, but the largest and most practicable source is to be found in the giant kelps of the Pacific littoral.

We have received the first part of the *Palaeontologische Zeitschrift* (Berlin: Gebrüder Borntraeger, price 25 marks annually), the publication of the Palæontologische Gesellschaft, which was founded in Germany last autumn. The society is intended to be of an international character, and besides about 130 German palæontologists, it already counts nearly eighty members in other countries. The headquarters are in Berlin, and a meeting is to be held once a year in some locality, either in Germany or in another country, where there is an important collection of fossils or where the fossiliferous strata are of special interest. The first president is Prof. Otto Jaekel, of Greifswald, and on the council the representatives of Great Britain and the United States are respectively Dr. Smith Woodward and Prof. Charles Schuchert. The published *Zeitschrift* deals with fossils from every point of view, but especially in their biological aspect, and begins with a presidential address on the study of palæontology in general. Prof. Jaekel quotes O. Merkel's claim to have discovered that fossils were intelligently collected even so far back as the Bronze age. One or two examples of each of fifty-eight species of Tertiary shells are said to have been found, with two recent Mediterranean species for comparison, in a cinerary urn of this period. Prof. H. Rauff contributes an important illustrated paper on Pharetrone sponges, and Dr. C. Wiman discusses cases of the sudden destruction and burial of swarms or large troops of animals. Prof. Jaekel also begins an account of the remarkable discovery of numerous dinosaurs and other vertebrates in a clay-pit in the Upper Trias of Halberstadt, north Germany.

To the July number of *Symons's Meteorological Magazine* Mr. R. C. Mossman, of the Argentine Meteorological Office, makes an addition to his third article on southern hemisphere seasonal correlations (NATURE, July 17), showing that a relation can be traced between rainfall at Malden Island (South Pacific) and mean temperature at Punta Arenas (Magellan Strait) from May to August. When the rainfall at Malden Island is above the average the temperature at Punta Arenas is below the normal, and *vice versâ*. During the seventeen years 1890–1906 there are only two years, 1894 and 1904, in which the signs are the same, but in each of the four years 1907–10 a low mean temperature at Punta Arenas is associated with a deficient rainfall at Malden Island during the four months in question. Dr. Hildebrandsson has shown that an apparently well-established correlation may break down for a few years, and Mr. Mossman remarks that the case under discussion offers another instance of the snapping of the chain.

A MEMORANDUM on the meteorological conditions prevailing over various parts of the earth before the advance of the south-west monsoon in India, issued by the Director-General of Observatories on June 8, has been recently received. The distribution of pressure is most favourable when the latter is high in March, April, and May in Argentina and Chile, and low in May in the Indian Ocean; on the whole the general pressure conditions appear slightly unfavourable. The inferences to be drawn from the winds and rainfall in the Indian Ocean during the previous two months do not affect the present monsoon prospects very strongly, while the accumulations of snowfall lying on the hills are probably normal. Although no explanation is forthcoming, there is apparently a tendency for years of which the average pressure over India is high to be associated with a good monsoon in the succeeding year, and *vice versâ*; in 1912 pressure was in moderate excess, and the tendency therefore affords grounds for hope. From these indications all that can be inferred is that a large excess or defect in the total monsoon rainfall of India is unlikely.

THE electron theory makes the dielectric constant k of an electrical insulator vary so that $(k-1)/(k+2)$ is proportional to the density. Temperature, therefore, which has little effect on the density, should have little on the dielectric constant. Measurement has shown, on the other hand, that the effect of temperature on the constant is considerable, and Prof. Debye, of Zürich, recently suggested that this effect could be explained by the presence of electrical doublets in the dielectric so long as it is in the liquid state. The product of the absolute temperature into the expression above should then be a linear function of the absolute temperature. This Debye showed to be the case. In the *Verhandlungen* of the German Physical Society for June 30, Dr. Ratnowsky, of Zürich, shows that the dielectric constant should in these circumstances depend to a small extent on the electric field to which the insulator is subjected. A series of measurements by him on a solution of amyl alcohol in benzol made by the alternating-current bridge method has confirmed this deduction and gives the number of doublets per cubic centimetre and their electrical moment in fair agreement with the values found by Debye.

WE have received vol. vi. of the Journal of the Municipal School of Technology, Manchester, which consists of a reprint of the scientific and technical papers which have been communicated to societies or published in the technical Press by members of the staff or by students of the school during the year 1912. Nineteen such papers cover the 267 pages of the journal, and deal with subjects like the investigation of the best form and speed for durability of cutting tools, the forces which produce corrugation of tram rails, the properties of porcelain insulators used in high-tension electrical power transmission, the influence of alkalis in the dyeing of cotton, the action of metallic chlorides in sizing cotton yarn, the action of light on colouring matters. We know of no other technical school in this country which can show so valuable a series of researches turned out in a single year, and we wish the Manchester School every success in its avowed intention, by offering "systematic training in the principles of science and art as applied to industry," of producing "men of character, wide knowledge, and practical experience," and so fostering industry.

THE Optical Convention held at South Kensington on June 19–26 of last year was described in an article published in the issue of NATURE for June 27, 1912 (vol. lxxxix., p. 435). The Proceedings of the convention have now been published for the University of London Press, Ltd., by Messrs. Hodder and Stoughton. The handsome volume runs to 359 large pages, and contains the inaugural address of the president, Prof. S. P. Thompson—extracts from which were published in Nature of the date mentioned—and the papers read at the convention. The papers are chiefly of a technical description, largely directed to the issues of technical inquiry, and a few are devoted to the details of manufacture. Among the contents of the volume of more general interest may be mentioned the report of Prof. Turner's lecture on the great observatories of America, and Prof. Stirling's popular lecture on optical illusions. A table of constants for calculating spherical aberration forms an appendix; this comprises a selection of logarithms of use in some of the more laborious calculations which the designers of lens combinations have to make. The price of the volume is 10s. net.

The National Academy of Sciences of the United States of America was founded in 1863, and 1913 sees completed the fiftieth year of its existence. It was decided in 1909 to have prepared for publication, in connection with this semi-centenary of the academy, a volume containing as complete an historical summary as could be brought together in the time available. A committee was appointed to take charge of the matter, and in the summer of 1910 the services of Dr. F. W. True were secured as editor. The result of the labours of this committee is seen in the "History of the First Half-Century of the National Academy of Sciences, 1863–1913," a copy of which has reached us from Washington. It was hoped that a list of the scientific communications presented to the academy since its foundation, some two thousand in number, might be added to the volume, but it has been found impossible in the time available to compile the necessary data. The completion of the undertaking is deferred until a later date. The present handsome volume runs to some 400 large pages, and gives exhaustive information as to the founding of the academy, its annals, and its work as scientific adviser of the U.S. Government. Biographical sketches of the incorporators of the academy add interest to the work, while the numerous appendices provide most useful lists of members, medallists, officers, and so on.

Mr. Francis Edwards, 83 High Street, Marylebone, London, W., has published the August issue of his catalogue of second-hand books in all classes of literature. The volumes listed include a number from the library of Mr. Thomas Pennant, the antiquary and naturalist.

OUR ASTRONOMICAL COLUMN.

August Meteors.—The most interesting and important season of the year for meteoric work has now arrived. The Perseids return regularly in August, and always repay observation, though there are marked variations in their annual displays.

During the last few years this shower has scarcely justified expectation, but the conditions have not been very favourable. At the ensuing return possibly the meteors may return in their old-time abundance, but there will be a little interference from moonlight before midnight. This need not, however, materially affect the character of the display, for on the nights of August 11 and 12, when the maximum will occur, our satellite will be only just past the first quarter, and will set on August 11 at 11h. 13m., and August 12 at 12h. 9m. p.m.

It seems desirable to watch the phenomenon closely every year for several reasons. Its period is not yet exactly ascertained, and we are not sufficiently well acquainted with its annual variations. The hourly number of meteors visible should be determined, and the time of their maximum abundance. It is also important to record the apparent paths of such brilliant meteors as may be visible.

In the case of fireballs the lingering streaks give evidence of rapid currents in the upper atmosphere, and should be specially watched. It will be useful to note the position of the streaks amongst the stars and to record the rate and direction of their drift, at short intervals, during the period of their visibility. The streaks are usually from sixty-five to fifty-five miles in height.

Directly a streak is seen a telescope or field-glass should be directed towards it. A streak which remains visible to the naked eye a few seconds can sometimes be watched for five or ten minutes with a glass.

It is astonishing how many of the meteors of the August stream are destroyed every year by collision with the earth's atmosphere. Basing calculations on observed facts, it is probable that between 80 and 100 millions of these meteors are encountered every year. This great annual expenditure might be thought to have a perceptible effect in diminishing the visible numbers, but when we remember that Prof. H. A. Newton computed the number of meteors in the August system as 300,000,000,000,000, it is certain that any apparent falling off in the richness of the shower would only become sensible after many thousands of years.

Displacement of Spectrum Lines of Metals due to Impurities.—An important piece of research work, chiefly interesting to spectroscopists, is that recently communicated by M. Keivin Burns to the *Comptes rendus* for June 30 (vol. clvi., No. 26, p. 1976). M. Burns finds that the presence of a large proportion of luminous vapour in an arc of iron or mercury displaces the spectrum lines of those metals contained in a small proportion in the arc (such as barium, manganese, cadmium) in relation to the positions they would occupy if the metals which produced them were predominant. He suggests that this displacement may be the result of numerous particles in a special condition where they emit light and not of ordinary molecules or atoms; the displacement is not explained by a pressure effect. He points out that the existence of this displacement does not render it prudent to use such lines of impurities as standards in attributing the wave-lengths found from measures made under other conditions.

Circulation in the Solar Atmosphere.—Anyone who has closely studied a number of photographs of solar prominences photographed on the limb of the sun would have the idea of solar currents brought to his mind.

A systematic study of a large number of such photographs becomes therefore of extreme interest from the solar circulation point of view, and such a study has been undertaken by Prof. Slocum, of the Yerkes Observatory, from spectroheliograph photographs he has taken with the large Yerkes refractor. His second paper on the subject appears in *The Astrophysical Journal* (June, vol. xxxvii., No. 5), and the conclusions at which he arrives can be best conveyed in his own concise summary. Many prominences, by their shapes or movements, seem to indicate the existence of a horizontal current in the solar atmosphere. This current may have opposite directions at different altitudes in the same locality. It may change its direction, just as the wind changes upon the earth. In middle latitudes the average tendency for movement is towards the poles. In high latitudes the tendency is towards the equator. This tendency is more marked in the northern than southern hemisphere. From lat. 10° N. to 10° S. the average tendency is from north to south directly across the equator. The prevailing directions mentioned above apply to prominences of all heights.

THE BRIGHTON MEETING OF THE BRITISH MEDICAL ASSOCIATION.

A MEDICAL congress, especially in view of the wide development of specialism, rarely if ever helps to bring to light a new discovery or to promote a new theory, or at least to work out an application in practice of some basic theoretic facts. It has, however, the importance of grouping together men who work on widely different lines and are enabled to exchange ideas in a favourable atmosphere. In so far the Brighton meeting of the British Medical Association was undoubtedly very successful. We had, for example, a very interesting address by Prof. C. G. Barkla, F.R.S., on the secondary X-ray radiations in medicine, which, being delivered by a prominent physicist, introduced an element of exact science into empiricism of therapeutic applications. Prof. Barkla gave a detailed description of the scattered, fluorescent, and corpuscular rays. He reminded his audience that all chemical, therapeutic, and physical action attributed to X-rays was due to the secondary radiation of negative electrons. He pointed out that in order to produce a definite effect in an organ there must be a transformation of the energy of Röntgen radiation into energy of corpuscular radiation, as well as an absorption of the latter by the respective organ.

The solid basis and irrefutable arguments of physics could not be found or expected in the discussion on anaphylaxis. This was opened by Prof. W. E. Dixon, who entered into various details of the condition of experimentally produced hypersensitiveness, describing the changes occurring in the muscular and circulatory systems, and emphasising the significance of local symptoms. When he came to declare his preference for one of the three leading hypotheses as to the causation of the "anaphylactic shock," he declared himself in favour of the ferment theory, because he regarded the "classical" side-chain theory as a purely speculative hypothesis, and the more recent "colloidal theory" as still being in its infancy, whereas he found the ferment theory to be based on carefully recorded physiological facts. Prof. G. Sims Woodhead and Dr. Myers Coplans gave examples of clinical conditions which may be looked upon as similar to that of experimental anaphylaxis. Prof. Woodhead made a very interesting remark as to the possibility of explaining some of the phases of pneumonia by the sensitisation of the system by the specific bacterial protein. He also referred to the view largely held as to the possibility of organs being specifically sensitised, as instanced by the uterine muscle in eclampsia.

Drs. Embleton and Thiele related the results of their very remarkable experiments, which have shown that by sensitising laboratory animals by injection of bacterial protein of purely saprophytic bacteria like *B. mesentericus* one may make them so highly susceptible that a subsequent inoculation of live bacteria of the same species will kill the animals under symptoms of acute septicæmia. These experiments are undoubtedly of a very wide importance, as they may help in producing typical specific disease conditions in experimental animals naturally refractive to the infection produced by ordinary means.

A less debatable basis for discussion was given by Prof. George R. Murray, who dwelt on the importance of internal secretion in disease in a masterly presidential address. He explicitly limited the name of "secretion" to the useful products of glandular activity which pass into the blood stream in order to play some definite part in metabolism. Ductless glands in particular act on other tissues by means of "hormones," which excite definite forms of chemical activity in cells for which they have a special affinity. The glandular cells may form more than one specific hormone; they may also produce "inhibitory hormones," *i.e.* substances which inhibit the chemical activity of the tissue cells instead of exciting them. He passed in review the consequences of an insufficient as well as superabundant supply of glandular hormones, and insisted particularly on the relations of the thyroid and pancreatic gland which tend to inhibit each other. This, as proved by further discussion, is one of the most important facts for the practice, as it tends to explain the machinery of diabetes and all forms of glycosuria. Dr. A. E. Garrod, F.R.S., could not discover any basis for a sharp differentiation of the diabetic and non-diabetic glycosurias. In his belief the progress of research was strengthening the viewpoint that the internal secretion of pancreas was the almost only controller of carbohydrate metabolism in the system. The peculiar forms of glycosuria without a definite diseased condition he tried to explain by a disturbed correlation between the various glands of internal secretion.

A general impression gained from all the various discussions can be summarised in that the medical profession is fully alive to the importance of "control" experiments, that it errs rather in the application of a severe criticism to its scientific contributions, and keeps to the moral, "Prove all things, holding fast that which is good."

HYDROGRAPHIC AND PLANKTON OBSERVATIONS IN THE NORTH SEA.

WE have received from the Board of Agriculture and Fisheries the subjoined communication relating to observations to be made in the North Sea:—

The research vessel s.y. *Hiawatha*, chartered for fishery research in the North Sea, left the Tyne on Tuesday for the purpose of making certain practically continuous hydrographic observations, at a fixed position during the first fortnight of August. She will be taking part in a coordinated research into the movements of the great water masses in the North Sea, and for this purpose she will drop her anchor about 150 miles "E. by N. ½ N." of Shields and commence her work. Her labours will be identical in aim and in the main in methods with researches simultaneously carried out on board eight other vessels, also at anchor, at positions which collectively will permit of the study of conditions representative of the hydrographic conditions over the whole of the North Sea.

Two of these other vessels will be research vessels, acting on behalf of Sweden and Scotland, the Swedish vessel working in the Skagerak, the Scottish well to the north-east of Aberdeen. The remaining vessels are light vessels, two acting for Holland, the other four, by courtesy of the Brethren of the Trinity, for the English department.

The observations will consist of current measurements made near both surface and bottom every hour night and day, throughout the fortnight, and in fine weather at other intermediate depths. Special attention will be paid to the submarine waves which are, it is expected, to be met with at the depth at which the heavier bottom water and the lighter surface water are in contact; but information will be obtained as to all layers. Specially devised current meters are used in this work, some depending for their operation on small propellers, resembling those of an anemometer and worked by the current, others upon the deflection of a wire from which a metal cylinder depends, caused by the force exerted by the current. The temperature and salinity of the various layers of the sea will also be ascertained in the course of the work, special water-bottles being employed to secure samples of the sea from any desired depth. Samples of the minute floating organisms which, directly or indirectly, constitute the food of all our food fishes will also be taken at various depths and at the extremes of the tide.

Some idea of the scale of the operations may be gathered by the fact that it is expected that some 8000 independent current measurements will be made from the English vessels alone.

The hydrographic operations are planned by a special committee of the International Council for the Exploration of the Sea. They are undertaken because a knowledge of the constitution and movements of the sea-water is essential to the understanding of the movements and even of the abundance of the fishes upon which our fishing industry depends. As a classical instance, the herring of the Kattegat and Skagerak may be cited. Its abundance or scarcity has been found to be connected directly with the amount of water which enters the Baltic from the North Sea; and, indeed, not only the herring fishery but other fisheries of southern Sweden have been shown to change with the ebb and flow of this layer of cold salt water. It is clear, in fact, that a state of knowledge of marine currents which would permit of prognostication as to their movements and volume at a later period would in the case of many fisheries permit the fishermen to reap the utmost harvest which the year would afford or to anticipate a time of scarcity and take such precautions as were possible to mitigate its effects.

A NEW METHOD OF COOLING GAS-ENGINES.

THE summer meeting of the Institution of Mechanical Engineers was held in Cambridge last week. Among the many papers read and discussed, that by Prof. Bertram Hopkinson, of Cambridge University, takes a prominent place; the subject of the paper was a new method of cooling gas-engines. The most important peculiarity of the gas-engine, that which determines the characteristic features of its design and operation, is the heat-flow from the hot gases into the cylinder walls. About 30 per cent. of the heating value of the fuel passes into the metal of the engine in this way. The method hitherto employed in removing this heat has been by the circulation of water in jackets, except in the case of small air-cooled engines. In large engines, the piston and exhaust valve have also been kept cool by circulation of water. The appliances necessary for the carrying out of this method have been responsible largely for the great weight and cost of large gas-engines.

Water circulation has secondary effects which tend to make a large engine untrustworthy in working. The cylinder walls in places may be 3 in. thick or more. To cause the heat to flow from the inner to the outer surface of the metal requires a temperature difference of the order of 50° C. per inch, and this may become serious with thick walls. It is also difficult in large engines to secure adequate circulation about all parts of the cylinder walls and piston, and some parts may be much hotter than others. Severe stresses may be set up in consequence of the unequal expansion, and the overheating of certain parts of the inner surface is apt to cause pre-ignition of the charge. In consequence of the dangers of overheating it has been found impossible to work gas-engines, especially of large size, continuously at the maximum power which they can develop.

In Prof. Hopkinson's method of cooling, water is injected internally in thin jets directed against the walls of the combustion chamber and the end of the piston. There is thus no heat flow through the metal and no difference of temperature between the inner and outer surfaces. The water is so distributed that each part receives it in proportion to the rate at which it receives heat from the hot gases. Practically uniform temperature all over is thus maintained, and the stresses due to unequal heating are eliminated. A simple single-walled casting can be used for the cylinder, resulting in a great saving in weight and cost and in improved trustworthiness on account of the elimination of casting stresses. Piston-cooling arrangements—a frequent cause of trouble—can be dispensed with. Finally, pre-ignitions are entirely prevented.

To obtain success in this method of cooling, the water must be projected in comparatively coarse drops or jets directly against the surfaces to be cooled, so that it reaches these surfaces in the liquid form without much loss by evaporation on the way. Water which reaches the walls in the liquid form, and is there evaporated, absorbs, out of the heat given to the walls by the gas, the *whole* of its own heat of evaporation; there is no loss of thermodynamic efficiency because the heat used is waste heat, which in a jacketed engine would go to warm the cooling water. Any steam formed in this way is pure gain; and, if anything, there is an increase in the work done.

Further, if the cylinder walls are allowed to become and remain wet, they are destroyed rapidly by corrosion. This is due to the presence of sulphur dioxide in the gas, which forms sulphurous acid when dissolved in water. This difficulty has been overcome by regulating the amount of water injected in such a way that the temperature of the whole of the engine is kept well above 100° C. Under these conditions every drop of injected water is boiled when it reaches the walls, and no liquid can accumulate. It is found to be sufficient to inject water on to the surface of the combustion-chamber and the head of the piston only; the cooling of the barrel is effected by conduction into the piston. Thus no water falls on the sliding surfaces, where it would cause damage by the dissolved salts producing grinding.

Trials have been made on a Crossley engine fitted with a new cylinder embodying the principles explained above. The cylinder is 11½ in. diameter by 21 in. stroke, and is rated at 40 brake horse-power at 180 revolutions per minute. The success of this engine, as compared with the original water-jacketed cylinder, has been remarkable. After considerable preliminary trials, the engine was put to drive a dynamo in a factory engine-room, at a speed increased to 195 revolutions per minute. It developed frequently 50 brake horse-power with coal gas for several hours together. Since then the engine has been taken to Cambridge, and is now engaged in regular service with a suction-producer, driving the workshops, and producing electric current for the engineering laboratory. It is left to itself like an ordinary gas-engine, giving no trouble at all, and has been in regular work for two years, the total time of running being 5000 hours.

Judging from the success which has so far been obtained, it seems likely that Prof. Hopkinson's method of cooling the cylinder will revolutionise the design and construction of large gas-engine cylinders.

RECENT PAPERS ON VERTEBRATE PALÆONTOLOGY.

A VERY remarkable announcement is made by Mr. J. W. Gidley in vol. lx., No. 27, of the Smithsonian Miscellaneous Collections, namely that an associated series of five upper cheek-teeth of a large ruminant from a Pleistocene cave-deposit near Cumberland, Maryland, U.S.A., indicate an antelope apparently closely related to the elands of Africa. So near, indeed, is the resemblance that the author deems himself justified in referring the fossil to the existing genus, under the name of *Taurotragus americanus*; and the plate showing these teeth alongside those of the existing *T. oryx* goes a long way in confirming his conclusion. It should have been mentioned that the present writer (see Cat. Siwalik Vert. Ind. Mus., part i., p. 1885) has provisionally referred certain teeth from the Indian Siwaliks to Taurotragus (= Oreas); and if the identification be correct, it would explain how eland might have reached America from Asia by the Bering Sea route. Mr. Gidley quotes the occurrence in the Pleistocene of Nevada of remains of certain ruminants described as Ilingoceros and Sphenophalus as corroborative evidence of the former existence of tragelaphine antelopes in America; but he omits to mention that although these genera were at first assigned to that group, they have been subsequently regarded as akin to the American family Antilocapridæ (Merriam, Bull. Dept. Geol. Univ. California, vol. vi., p. 292). If this be correct, is it quite impossible that the supposed eland represents another member of the same group?

In a second communication (*op cit.*, No. 26) Mr. Gidley records the occurrence of a toe-bone of a camel in a superficial deposit at the mouth of Old Crow River, in the Yukon Territory, in association with remains of mammoth, horse, and bison. The occurrence of the camel-bone confirms "the theory of the existence of a wide Asiatic-Alaskan land connection of comparatively recent date, which for a very considerable length of time served as a great highway for the free transmission of mammals between America and the Old World."

As being only in part palæontological, brief notice must suffice for a paper, by Mr. K. S. Bardenfleth, on the form of the carnassial tooth in Carnivora, published in *Vidensk. Meddel. Dansk. naturh. Foren*, vol. lxv., pp. 67–111. After reviewing the various theories of the homology of tooth-cusps, the author proceeds to observe that in order to demonstrate that the simple reptilian tooth-cone is represented by the middle one of the three longitudinally arranged cusps of the Purbeck Triconodon, and that the tritubercular crown has been formed by rotation of the other two, indisputable evidence has yet to be furnished, "first, of the Triconodon-like forms being the ancestors of Dryolestes, &c.; second, of the supposed protocone and protoconid of these being really homologous with the median cusp of Triconodon. One can scarcely imagine how such a rotation could take place, and if Gidley is right in his interpretation of the molar cusps of Dryolestes, the rotation has not taken place, but the so-called protocone is a secondary acquirement; the true protocone is still to be sought in the central one of the three outer cusps. If this holds good the whole nomenclature and theory of Osborn falls to the ground; neither protocone nor protoconid are then identical with the reptilian cone."

Three papers, by Dr. R. Broom, form part 6 of vol. vii. of the Annals of the South African Museum, and relate to the extinct reptiles of the same country. In the first of the triad the author shows that while in Pariasaurus the digital formula is 2.3.3.4.3, in the allied Propappus it is probably 2.3.4.5.3. In the second he describes, as *Noteosaurus africanus*, a new genus allied to Mesosaurus, of which three of the known species are South African, while the fourth is Brazilian. The last paper comprises a classified list of the early Mesozoic reptiles of South Africa, which, apart from dinosaurs, crocodiles, rhynchocephalians, &c., are arranged in no fewer than nine ordinal groups, brigaded in three "superorders." R. L.

AN ALGEBRA FOR PHYSICISTS.[1]

THE principal novelties in Dr. Macfarlane's calculus are that a distinction is made between linear and cyclic successions of vectors, and that the commutative law of addition, as well as that of multiplication, is abandoned. To express what most vectorists write $\beta+\alpha=\alpha+\beta$, Dr. Macfarlane writes $\Sigma(\beta+\alpha)=\Sigma(\alpha+\beta)$. Thus $\alpha+\beta-\alpha$ is not the same as β, but either three sides of a parallelogram, or three coinitial vectors, according as we take linear or cyclical succession. By introducing some subsidiary and rather artificial rules, the author is able to get formulæ that are, in appearance, analogous to the binomial and exponential theorems, and so on.

The actual divergence from quaternion results is not very great, as may be easily shown by an example. Let x be a scalar, α a unit vector, and let $\exp(x\alpha)$ be defined to mean $\Sigma(x\alpha)^n/n!$. Then $\exp(x\alpha)=\cos x+\alpha\sin x$, and if y is another scalar, $\exp(x\alpha).\exp(y\alpha)=\exp(y\alpha)\exp(x\alpha)=\exp\{(x+y)\alpha\}=\cos(x+y)+\alpha\sin(x+y)$.

But, if β is another unit vector,

$$\exp(x\alpha)\exp(y\beta)=\cos x\cos y+\alpha\sin x\cos y+\beta\cos x\sin y+\alpha\beta\sin x\sin y,$$

which differs from $\exp(y\beta).\exp(x\alpha)$, while both, in general, differ from $\exp(x\alpha+y\beta)$: the latter, observe, being by definition the same as $\exp(y\beta+x\alpha)$. Dr. Macfarlane, after writing down his exponential formula, breaks it up into four parts, practically the same as the four given by the quaternion formula above, when written in the form—

$$\exp(x\alpha)\exp(y\beta)=(\cos x\cos y+\sin x\sin y\,S\alpha\beta)+\alpha\sin x\cos y+\beta\cos x\sin y+V\alpha\beta.\sin x\sin y.$$

It must be left to physicists themselves to decide whether Dr. Macfarlane's new algebra is superior to those already available; the need of a sign to express a resultant is a rather severe handicap. To the pure analyst it presents the appearance of a conglomerate, though possibly, with a change of notation, it could be fitted into a place in the family of linear associative algebras. One thing ought to be said: it is not, properly speaking, an "extension" of quaternions. Analytically, the calculus of quaternions is a linear algebra of a perfectly definite type,

[1] (1) "Account of Researches in the Algebra of Physics," I.–III. (Reprint from Journ. Wash Ac. of Sc., 1912)
(2) "On Vector-analysis as Generalised Algebra" (Intern. Congress of Mathematicians, 1912.) By Dr. A. Macfarlane.

just as an oak is a perfectly definite type of a tree. Taking $q=x+yi+zj+wk$ as the type of a quaternion, we may generalise the "scalars" x, y, z, w, by making them ordinary complex numbers, or elements of some other algebra, commutative with i, j, k, and combining according to laws of their own. We thus embed the quaternion algebra, so to speak, in a larger composite algebra; but it is most undesirable to call this an extension, still less a completion, of quaternions.

The reader should be warned that the author often says "must" when there is no logical necessity at all. For instance, we are told that, β having one dimension in length, β^2 "must" have two; yet on the next page we are told that $\alpha\beta\gamma\delta$ means a solid angle, thus apparently having no dimensions in length, at any rate not four. This kind of fogginess is very common, even among quaternionists. Thus $ij=k$, so the product of two vectors can be a vector, and the law of dimensions is violated, or rather does not apply. Of course, in physics, it is convenient to represent areas, moments, &c., by vectors, and then the quaternion formulæ become more significant. We might, if we liked, put $ij=k_2$, $jk=i_2$, $ki=j_2$, regarding i_2, j_2, k_2 as areal units, and then have what Grassmann would call a regressive multiplication, $i_2j_2=k$, $j_2k_2=i$, $k_2i_2=j$, bringing us back to one dimension again. But anyone can see that this is unnecessary complication; in all physical applications of quaternions it is easy to see whether a vector is to be interpreted literally, or as the representative of some areal quantity.

Whatever may be the ultimate fate of this particular algebra, Dr. Macfarlane's researches deserve recognition. He has the spirit and the courage of a heretic, and every honest heretic helps to advance the truth.

G. B. M.

UNITED STATES METEOROLOGICAL PUBLICATIONS.[1]

(1) THE first thirty pages of the report of the Chief of the Weather Bureau for the year 1911–12 contain a summary of the work accomplished by that department during the year. This is followed by a general statement of the weather conditions prevailing in the individual months, while the last and by far the longest part of the report is devoted to tabulated statistics of the different meteorological elements with summaries of sunshine, excessive rainfall, &c.

An account of the work done at the upper-air station on Mount Weather is given first place in the volume, and from this we learn that it is proposed to modify the plan hitherto followed of attempting to obtain a kite or balloon flight on each day, regardless of the weather conditions, and to substitute a series of special ascents made to investigate particular problems. It is interesting to learn that a special department is being inaugurated at this observatory for the training of observers for duty at the 200 out-stations of the weather service. At the central office a synoptic weather chart is prepared each day for the whole of the northern hemisphere, and on this map are based general forecasts of the weather and temperature conditions over the United States for a week in advance. It is intended shortly to institute a service of wireless reports from ships in the Atlantic, and to transmit information as to the location and movements of dangerous storms to vessels from one of the high-power stations on the coast. Extensive observations are now being made on the snowfall of the western mountain ranges, and it is hoped to be able in the future to give useful forecasts of the flow of those rivers which are fed in the spring and summer by the thawing snow. A feature of the report is the list of new books added to the library during the year. Many of the more important of these works are referred to individually, and a short account is given of the scope covered by each book. This should prove useful for purposes of reference. It is evident from a perusal of the volume that the operations of the bureau are conducted on a very large scale, as befits an institution dealing with meteorological information from an area like that of the United States.

(2) The impending opening of the Panama Canal renders the subject of the second paper of especial importance at the present time. In addition to dealing with the West Indian hurricanes, the author sets out comparative data for the typhoons of the Pacific and the cyclones of the Bay of Bengal. All these disturbances are of the same type, characterised by a moderate decrease of atmospheric pressure to within forty or fifty miles of the centre, and then the rapid fall associated with the destructive winds which cause such havoc in the belt passed over by the central region of the disturbance. Nearly all the West Indian hurricanes have their origin in a well-marked area bounded by the parallels of 12° and 26° N. latitude, and lying between 56° and 90° W. longitude. The typical track is parabolic in shape, the storm moving W.N.W. at first, then curving round to the N., and finally passing in a north-easterly direction to the North Atlantic. The average rate of travel of these storms is only 300 miles per day, so that the forecaster is often enabled to give a fairly long warning of their approach. Much useful information is contained in the paper, and Dr. Fassig is to be congratulated on the completion of a trustworthy piece of work.

J. S. D.

[1] (1) Report of the Chief of the Weather Bureau, 1911–12.
(2) Hurricanes of the West Indies, Dr. O. L. Fassig.

REFLECTION AS A CONCEALING AND REVEALING FACTOR IN AQUATIC AND SUBAQUATIC LIFE.[1]

AS a result of observations and experiments carried out on ponds built for the purpose, and by the use of apparatus for observing organisms in their natural environments, I have arrived at certain conclusions as to the value of reflection as a concealing factor in various forms of aquatic and subaquatic life. The general principle upon which these ponds are built is as follows:—In one bank of the pond is a glass window, and beyond this window an underground observation chamber. No light enters this chamber except through the surface of the water. By this means everything in the pond is seen by *entirely* natural illumination, the observer cannot be detected, and as there is no reflection from the glass the making of photographic records is greatly simplified. In the first pond, built for the observation of objects in the water, the glass is perpendicular. In the second, for observing objects on the surface, the glass is at an angle of 45° to the surface.

Of apparatus I use a tube 18 in. square and 5 ft. long. On one side at the lower end is a window; into this tube slides a reflex camera, so that the lens is opposite the glass. When in use, a heavy weight carrying a hook is lowered into the water, with the end of the tube attached to the hook. The whole apparatus can be tilted at any angle, and by this means the incident rays from any object in any position—except overhead—are made to strike the glass at right angles, and thus distortion, due to refraction through the glass, is rendered negligible.

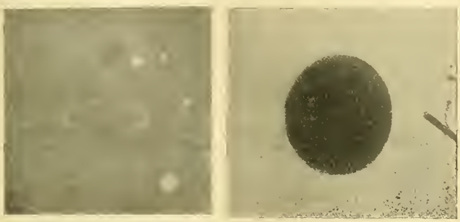
[1] Discourse delivered at the Royal Institution on Friday, June 6, by Dr. Francis Ward.

The apparatus has been mainly used as a check upon observations in the ponds.

For observing and photographing life on the bottom, I use a tube 3 ft. long, with a glass partition inside, a foot from the end. This apparatus acts as a boat-like sea telescope, and is fitted with a camera. Lastly, through the kindness of Prof. Herdman, I have established at Port Erin a large wooden tank above ground. Three sides of the tank incline at an angle of 45°; the fourth is perpendicular. In the perpendicular side is a glass window, and attached to it an observation box, 6 ft. by 4 ft. The tank and observation box revolve together on a platform; by this means an object in the tank can be seen by reflected and transmitted light at will.

It is usual to consider pigmentation as the main factor in the concealment of subaquatic life. Among organisms that live in more or less the same character of surroundings, pigmentation is undoubtedly most important; but in the forms of life that are constantly changing their environments, the best concealed are those that most effectively reflect their surroundings.

When, however, an organism depends mainly upon reflection for its concealment, the reflection of light from above has to be modified, or else the organism is revealed. In some forms of life, particularly fishes, pigmentation upon the back is the method of modifying this reflection from above. In other forms this top light is cut off by position, *e.g.* in light-coloured



White saucer on the surface in the area of total reflection. White saucer on the surface in the circle of light.

Fig. 1.

anemones, which are only to be found attached to the under-surface of shelving rocks.

Before proceeding further, I would like to illustrate the appearance of a white object, as seen from under the water. I show a sheet of white cardboard pinned on a red stick, which in turn was stuck in the centre of an *empty* pond. The sides and bottom of the pond were covered with green confervæ. In this position the card appeared white, and incidentally the stick red.

The pond was then filled up with water, and now the white card so exactly reflected the colour around that it became practically invisible, yet its position was revealed by a streak of light along the upper edge of the card.

In nature all white subaquatic organisms reflect in a similar manner, and white is never seen under the water, except when there is no provision made for modifying the reflection of light from above, or when the organism turns on its side.

As an illustration of this point, let us consider the white anemone (*Actinoloba dianthus*). I show a colour-plate of this anemone attached to the top of a rock and, of course, it appears white, but as soon as it moved only a distance of 2 in. under the shelving edge of the rock, the top light was cut off, and you will see the white anemone appears green as it reflected the prevailing colour below.

It will be noticed that the white serpula on the rock reflects in the same manner; and as the light parts of rock also appear of a greenish colour the anemone and the serpula are practically invisible. Advisedly I say practically invisible, for the greenish anemone when closed makes a uniformly shaded green mass against a patterned rock.

It will have been noticed that the red stick holding the white card, when seen from under the water in green surroundings, appeared a dull black.

When *Tealia crassicornis* (a red and white anemone) is attached to the under-surface of a rock with a green coloration below, the whites of this anemone appear green and the red markings appear dark, so that now the anemone shows a general green coloration with dark markings upon it, which fit in with the dark markings on the stone. Many forms of light-coloured marine life are found under shelving rocks. I consider they escape destruction in this position owing to the fact that they reflect their surroundings.

Next let us consider the modification of reflection by pigmentation. This is best illustrated in fishes. Until one has observed fish by *entirely* natural illumination, it is difficult to realise how important a

Fig. 2.—Lesser black-backed gull on surface in area of total reflection. (From life.)

part reflection plays in rendering both silvery and highly pigmented fishes inconspicuous.

The silvery fish does not appear silvery, but red, brown, or green, according to the general colour around, and in addition it will reflect upon its body stem for stem the reeds into which it has rushed in order to hide itself.

As an illustration to show how a highly pigmented fish reflects light, I show a tench, only 6 in. under the water, and it will be seen the dark back appears quite silvery.

Pigmentation on the back conceals a fish against the bottom, but undoubtedly the important function is to conceal it, for protective and aggressive purposes, from other fish on the same level as itself. I would point out that the same light which is reflected from the sides of the fish, through the eye of the fish, controls the amount of contraction of the pigment cells on the back: thus the reflection from above is correctly modified, and the fish is rendered a uniform shade. But this uniform shade only conceals against a uniform background.

Thayer has shown in the animal world how th counter-shaded bird, or beast, without markings, when seen against a patterned background, becomes conspicuous, because it interrupts the pattern. The same is seen in the fish world, and in illustration I would direct your attention to the appearance of a perch (*Perca fluviatilis*) swimming past a reed bed.

In the autochrome of a brown trout lying under a stepping-stone, I show the value of reflection; here, the back green, and the belly red, as they reflect the stones above and below, are undoubtedly the main factors in concealing this fish, and the markings simply prevent the body from appearing patternless.

I would next direct your attention to the possible influence of reflection of light, from some forms of marine vegetation, upon the pigmentation of various marine organisms. Several red and brown seaweeds seen by transmitted light appear red and brown, but when seen against a dark background they reflect at various points a brilliant bluish-purple colour. Chondrus shows this well. In certain positions the whole side of a dark rock, covered with red and brown seaweed, shows blotches and streaks of bluish-purple. This is well marked upon the concrete blocks on the old breakwater at Port Erin.

FIG. 3.—Cormorant on surface dipping head under water. (From life.)

Lobsters, crabs, and many other forms of marine life, usually found in crevices among dark rocks covered with red and brown seaweeds, show a pigmentation exactly similar in appearance to the colour reflected from the seaweed. This is particularly well marked in the swimming crab, *Portunus puber*.

I would now refer to the appearance of life on the surface, as seen from below. This appearance entirely depends upon the position that the particular organism occupies on the surface, relatively to the point of observation from below the water.

On looking up to the surface, an observer sees above him a circle of light, through which he can see the sky and clouds. Beyond this circle there is total reflection, and the surface of the water reflects the general colour below. Transparent organisms are practically invisible, both in the circle of light and beyond. Now it is generally understood that forms of life that occasionally or habitually float on the surface are white underneath, so as to conceal them against the clouds and wave foam.

In dealing with this subject it is necessary to make a difference between white organisms that are opaque and those that are translucent. Commencing with the opaque, I will illustrate the point with the appearance of a thick white saucer. This was floated from some distance over my head. Outside the circle of light the surface of the water was reflecting the green bottom of the pond, the white saucer did the same, and, therefore, was invisible against the surface of the water. When, however, it came into the circle of light it still reflected the dark colour below and was revealed as a well-defined dark object against the sky and clouds.

A white-breasted gull swimming on the surface is concealed and revealed in an exactly similar manner. Therefore, an opaque white organism in the circle of light is not concealed, and when seen against the clouds the whiter the object the more conspicuous it becomes, because it reflects the dark water below. A white object is, however, concealed by reflection in the area of total reflection.

How does this explanation affect the concealment of an opaque white object on the sea from a fish? The size of the circle of light on the surface depends entirely upon how far the fish is under the water, for lines drawn from the two ends of the diameter of the circle make an angle of 97° at the eye of the fish.

When the fish is some depth under the water there may be several white seagulls on the surface within

Shell of argonauta on the surface in circle of light. Shell of argonauta on the surface in area of total reflection.

FIG. 4.

the circle of light, but as the fish comes up to feed his circle of light is narrowed down, and the gulls slip into the area of total reflection and by reflection become invisible to the fish.

For my experiments with translucent organisms I used the shell of an argonauta. In the circle of light you will see the shell is still very obvious, but as it transmitted a considerable amount of light it did not appear black like the white saucer. In the area of total reflection, however, the shell appears white, for in consequence of not being an opaque object it is no longer a reflector.

Argonauta seems to slip between two stools; it is too opaque to be concealed in the circle of light, and too translucent to be concealed in the area of total reflection. In the latter situation it certainly may be protected by simulating the appearance of wave foam, for wave foam in the area of total reflection appears as a flickering light.

So far we have only considered that portion of an object that is actually immersed. If, however, the organism under consideration is not too far distant, that portion of it above the water is visible on the edge of the circle of light, and the parts respectively above and below appear to be separated by a considerable interval of water surface. When the portion above the water is white, as in a gull, it is difficult to detect against the sky. The above remarks only refer to open water, and I will illustrate how a wading bird is concealed against the image of a reed-bed many yards behind him. Looked at from below the markings on a heron are in bold upright lines, for the plumage is greyish-white with black patches on each side of the head, and the black patches on the shoulders appear continuous with the black primaries of the wings. Seen against an open sky, the white parts of the wading heron blend with the sky, but the black parts stand up in bold relief. The head and shoulders of the bird are seen on the edge of the circle of light, but so also is the reed-bed many yards behind. The reeds, seen as perpendicular images, and the perpendicular markings on the heron blend, and thus make the bird inconspicuous.

2 4

1. Stuffed heron with neck straight out prepared to strike a fish.
2. Appearance of heron under the water. (From life.)
3. The same bird as he appears on the edge of the circle of light against the sky. Notice how the tree 160 ft. away and the body of the bird appear to be one.
4. Reeds were then placed 5 ft. behind the bird, and now his head and neck are not easy to detect.

When the above photographs were taken the lens of the camera was a foot below the water-level, and the heron was 4 ft. distant.

FIG. 5.

I have referred to white as a concealing agency. Black objects, when they retain air-bubbles on their surface, also become reflectors under the water. The black water-spider under a leaf appears green and is lost to sight. A waterhen swimming on the surface in the area of total reflection reflects the green weeds below, and becomes difficult to discern against the surface which is reflecting the same colour.

In conclusion, I will refer to reflection as a revealing factor. I have already illustrated this point with the anemone. I now show a slide of a shoal of young rudd wheeling round, and as they turn each fish is revealed as a flash of light as he catches the light from above.

Among diving birds the cormorant does not retain air bubbles in his feathers to the same extent as the loose-plumaged waterhen, yet by reflection he appears light or dark, according to the nature of the bottom over which he is swimming. When, however, the cormorant dives his track is marked by a series of brilliant flashes of light.

Now this bird when swimming on the surface has the habit of dropping his head under water at regular intervals—shags do the same. Seen from below, every time he does this, there is a flash of light not unlike the flash from a silvery fish turning. It is quite possible that fish, such as pollock and codling, are attracted by this flash, and thus swim towards their destroyer. These flashes of light are still better shown in the case of the penguin, and this I illustrate with individual pictures cut out of a kinematograph film.

I have had to leave the subject of refraction of light on the present occasion; first, because time does not permit of my dealing with it, and, secondly, because during the last fortnight I have tested all my experiments at Port Erin, and some of the results have made me reconsider the conclusions at which I had arrived with regard to the refraction of light in its relation to marine organisms.

TECHNICAL EDUCATION FOR INDIAN STUDENTS.

THE report of a Committee appointed by the Secretary of State for India to inquire into the system of State technical scholarships established by the Government of India in 1904, has been published as a Blue-book (Cd. 6867). On March 27, 1912, the Secretary of State appointed a Committee "to inquire and report as to the facilities available for Indian students for industrial and technological training in this country, with special reference to the system of State technical scholarships established by the Government of India in 1904." The Committee was constituted as follows:—Sir Theodore Morison, K.C.I.E. (chairman), Sir K. G. Gupta, K.C.S.I., Mr. J. H. Reynolds, Prof. W. E. Dalby, Mr. P. H. Dumbell (secretary), Mr. R. E. Field (assistant secretary). The Committee held its first meeting at the India Office on May 9, 1912, for the purpose of discussing the itinerary, and considering questions of procedure. On various occasions the Committee visited Glasgow, Leeds, Manchester, and Birmingham, where they received evidence from the higher education authorities, and visited the various laboratories, and so on, devoted to technical education. Altogether during the provincial meetings the Committee took evidence from seventy-five witnesses, of whom twenty-nine were professors and other representatives of the universities and technical colleges, twenty-eight gentlemen intimately connected with various industries as owners and managers of works, &c., and eighteen Indian technical students.

The information laid before the Committee at the four centres visited has been sufficient to enable it to prepare a report which will indicate the main lines of the policy which should be followed, but the inquiry as to the facilities available for Indian students for industrial and technological training is by no means exhausted, and it will, the Committee thinks, be necessary—if possible, early next session—for some representative of the Secretary of State to visit such centres as Sheffield, Liverpool, Bradford, and Newcastle, where it appears probable that special facilities exist for the study of particular subjects.

Among recommendations made by the Committee the following may be mentioned:—Students sent to this country should ordinarily have read in India up to the standard of the B.Sc. or B.A. with science, or have obtained an equivalent diploma. Exceptions may, however, be made in favour of students who have an hereditary connection with the industry which they propose to study, provided that they know enough English to follow lectures in this country.

Wherever possible, students should be familiar in India with the industry which they are sent here to study. In mining, this condition must in the future be enforced strictly, and no student be sent to the United Kingdom to study mining unless he has had at least a year's experience down an Indian mine.

The Local Governments should, in making selections, consult the business men and directors of industry in the province to a greater extent than appears to have been the practice hitherto. Business men are often likely to know of a promising lad who would make excellent use of a technical scholarship; they could also advise the Local Government as to the type of man whom the industries of the province need, and to whom they would readily offer employment.

Practical training in a business firm should be considered an integral part of the technical scholar's education, and consequently the period for which the scholarship is tenable should be extended so as to cover the time spent in undergoing such training.

A technical scholarship should not, except in rare cases, be tenable for more than five years, and in very few cases should it be granted for less than three; whatever duration is assigned to the scholarship it should be long enough to include a spell of continuous practical training. Wherever possible this training should be given in the United Kingdom.

The general effect of the recommendations will be to increase the cost to Government of the system of State technical scholarships. This additional expenditure will, however, be amply justified if in consequence of the changes the Committee proposes the men are better selected and better equipped for the work they have to do. Indeed, the expense of technical scholarships cannot be defended at all, says the report, unless they give the best preparation possible for the highest kind of industrial work. The ideal training for an industrial career is both lengthy and costly, and for this reason it should only be given, at public expense, to men of quite exceptional capacity. The average man, who can never be expected to do more than carry on well-known industries by well-known methods, can be trained in India; if he is trained in England it should be at private expense. But when the best men, so far as human foresight can discriminate, have been selected, it is false economy to give them any but the very best training.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The General Board of Studies will in the ensuing Michaelmas term proceed to appoint a University lecturer in surveying and cartography to hold office until September 30, 1916. Particulars of the stipend and duties of the lecturer can be obtained on application to the Vice-Chancellor. Candidates are requested to send their applications, with such testimonials as they think fit, to the Vice-Chancellor on or before October 11.

Mr. J. H. Burn, of Emmanuel College, has been elected into the Michael Foster research studentship.

The Royal Commissioners for the Exhibition of 1851 have, on the recommendation of the Vice-Chancellor, appointed Mr. I. Abrahamson, of Clare College, to an industrial bursary.

The Raymond Horton-Smith prize for 1913 is awarded to F. A. Roper and F. S. Scales, who are adjudged equal for theses for the degree of Doctor of Medicine. Subjects: "Creatinine and Creatin Metabolism, especially in Reference to Diabetes," and "The Electrocardiogram as an Aid to Diabetes." The M.D. degree committee expresses appreciation of the high standard attained by most of the theses submitted for the degree of Doctor of Medicine. Many of these theses, either records of clinical investigations on obscure diseases or of original laboratory research, ought, in the opinion of the committee, to be published. The theses submitted by Dr. A. Abrahams, on the analysis of nystagmus, Dr. H. T. Ashby, on the anæmias of infancy and childhood with special reference to the connection of iron with anæmia, Dr. A. F. MacCallan, on trachoma and Egyptian ophthalmias, and Dr. L. B. C. Trotter, on embolism and thrombosis of the mesenteric vessels, are adjudged worthy of special distinction. Amongst the theses not eligible to compete for the Raymond Horton-Smith prize that submitted by Dr. W. E. Hume, on a clinical and pathological study of the heart in diphtheria, attained a very high standard of merit.

London.—Since the appointment of a full-time secretary, the work of the Appointments Board, constituted by the Senate to assist graduates and students of the University in obtaining appointments, and to coordinate and supplement the work done by the schools and institutions of the University in this direction, has increased to a very considerable extent. The secretary, Dr. A. D. Denning, will be pleased to give further information as to the Board, and to see graduates, at the central offices of the University, South Kensington, on Wednesday afternoons, 2 to 5, or Thursdays, 12 to 1.30, or at other times by arrangement. Approximately 1000 posts have been notified to suitably qualified graduates registered with the Board within the last three months and many appointments secured.

By the will of the Right Hon. Stuart, Baron Rendel, of Hatchlands, Guildford, who died on June 4, the sum of 5000*l*. is bequeathed to the University College of Wales, Aberystwith, of which he was president.

We learn from *Science* that the General Education Board of the United States recently promised Washington and Jefferson College a grant of 20,000*l*. on condition that the college raised 80,000*l*. by June 30 last. On the date mentioned the college was able to announce that 88,000*l*. had been collected. Except for 10,000*l*., which is to be expended on a physics department, the entire sum now at the disposal of the college is to be added to the general endowment fund.

The organisation created by Lord Morley in 1909 for the benefit of Indian students included an Advisory Committee, and was mainly composed of influential Indian residents; fresh regulations have now been promulgated, we learn from *The Times*, giving the committee a definite constitution and specifying its functions. At least half of the committee are always to be Indian gentlemen resident in this country. The appointments are to be made by the Secretary of State for a term of three years. The functions of the committee are to keep itself informed as to the views of parents in India; to advise the Secretary of State; and to bring to his notice matters respecting the needs of the students. The committee has arranged to meet regularly on the first Monday in each month, and has appointed Sir M. M. Bhownaggree vice-chairman.

SOCIETIES AND ACADEMIES.

Paris.

Academy of Sciences, July 28.—M. F. Guyon in the chair.—Maurice **Hamy**: Study of the nitrogen radiations. The explanation of the width of the lines of the spectrum of rarefied gases, based on the Doppler-Fizeau principle, has been recently verified experimentally by Buisson and Fabry working with Geissler tubes containing the rare gases of the atmosphere. Similar work on nitrogen, a gas furnishing a band spectrum, is now described by the author, and he concludes that the band spectrum of nitrogen obeys the same laws as line spectra, as regards the difference of path required to make interference bands disappear. —E. **Jungfleisch** and L. **Brunel**: The sulphur set at liberty in the action between sulphurous acid and water. A study of the condition in which the sulphur is deposited in this reaction. Five photographs accompany the paper.—Lucas **Championnière**: Operation for club foot by ablation of all the bones of the tarsus. Osseous regeneration in young subjects. The operation consists in the removal of all the tarsal bones with the exception of the posterior portion of the calcaneum. A description of the results in forty-two cases is given. In young children there is distinct regeneration of a portion of the bone removed.—Couyat **Barthoux** and H. **Douvillé**: The Jurassic in the desert to the east of the Isthmus of Suez.—P. **Duhem**: The formula for the velocity of sound. A correction of a formula recently published by M. Ariès.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the second quarter of 1913. Observations were possible on seventy-seven days, and the results are grouped in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Rodolphe **Soreau**: An approximate formula for the arc of an ellipse.—E. **Stiemke**: Numbered moduli.—Kr. **Birkeland**: The conservation and the origin of terrestrial magnetism.—Georges **Claude**: The maintenance without difficulty of a temperature of $-211°$ C. by the use of liquid nitrogen. A rapid stream of hydrogen, 20 to 25 litres per minute, previously cooled by flowing through a copper spiral immersed in liquid nitrogen, is passed through about 0·75 litre of liquid nitrogen contained in a capacious Dewar vessel. The temperature rapidly falls, and after about twenty minutes remains steady at $-211°$ C., the melting point of nitrogen. At this point about two-thirds of the original liquid remains in the tube.—R. **Ladenburg** and F. **Reiche**: The absorption of coloured flames. It was shown more than thirty years ago by M. Gouy that the absorption of a coloured flame for the narrow lines of the spectrum which it emits is far from being complete, and that it was possible to calculate from his measurements the brightness of the lines as a function of the product of the thickness of the layer by the density of the metallic vapour. In the present paper these experimental results are compared with relations furnished by the electronic theory of dispersion. The two are shown to be in good agreement. If, on the other hand, the intensity of the lines is governed, not by the theory of dispersion, but by Rayleigh's theory according to the Doppler effect, then there is no agreement between the theory and Gouy's experiments.—E. **Briner**: The dissociation of the molecules into atoms considered as one of the factors of reaction velocity.—Victor **Henri** and René **Wurmser**: The negative photocatalysis of hydrogen peroxide. The stimulating or poisoning effect produced by certain substances on ferment actions has been hitherto ascribed to the action of the stimulant or poison on the ferment; the authors hold that this view must be modified in so far as this action may take place not on the ferment but on the body under transformation. In support of this view they adduce experiments on the photocatalysis of solutions of hydrogen peroxide in presence of traces of various substances, including sulphuric acid, caustic soda, iodine, potassium cyanide, &c. The addition of traces of these substances caused an increase of stability of the hydrogen peroxide towards ultraviolet rays.—F. **Bourion** and A. **Deshayes**: The quantitative separation of chromium and aluminium. The analysis of chromite. The method proposed is based on the use of a mixture of chlorine and sulphur chloride.—C. J. **Pitard**: Statistics and affinities of the flora of Chaouïa.—O. **Mengel**: The evolution of mildew according to the conditions of the medium.—Ch. **Julin** and A. **Robert**: *Ascidia fumigata*. Contribution to the study of the classification of the Phallusiideæ.—M. **Ruot**: *Bacillus lactis fermentens*, a spore forming butyleneglycol ferment of milk sugar. This organism produces an active fermentation of milk, 2:3-butyleneglycol accumulating in the culture, other products being carbon dioxide, hydrogen, acetylmethylcarbinol, acetic and formic acids.—Maurice **Renaud**: The irradiation of bacteria and the irradiated vaccines. For all the organisms studied irradiation with a quartz mercury-vapour lamp rendered the media sterile, leaving intact the histochemical properties. Irradiation prolonged beyond the period necessary for sterilisation does not diminish the activity of the soluble products of bacterial origin, such as toxins. The therapeutic application of irradiated cultures is discussed.—F. X. **Lesbre** and R. **Pécherot**: A calf born without the upper jawbone; a new Cyclocephalian type.—Eric **Gérard** and Hermann **Chauvin**: The waters of Spa. Radioactivity, electrical resistance, and cryoscopy.—J. **Ventre**: The influence of the yeasts on the variations of dry extract and of glycerol in wines.—L. **Lindet**: The soluble albuminoid matters of milk.—Ch. **Dhéré**: The diversity of hæmocyanines according to their zoological origin.

New South Wales.

Linnean Society, June 25.—Mr. W. S. Dun, president, in the chair.—C. **Hedley**: Studies on Australian Mollusca. Part xi. During 1912 the writer spent a furlough in Europe and America. Opportunities occurred for prosecuting conchological studies. Many types were examined, and much information was gathered from the Cumingian collection at the British Museum, the Lamarckian collection at Geneva, the collection of A. Angas at Newcastle, and that of Gould at Washington. Ten weeks were spent in constant study at the British Museum, during which almost the whole series of Australian marine gastropods and bivalves was examined. From these sources critical notes on 160 species, mostly from East Australia, are presented, to which are added illustrations of thirty hitherto unfigured species. Numerous corrections of nomenclature are offered, both in restoring prior names, and in re-erecting species wrongly sunk in synonymy.—E. W. **Ferguson**: Revision of the Amycterides. Part ii., Talaurinus continued. In continuation of last year's paper, the species comprised in Sections B and C and groups vii.–xx., inclusive, are now dealt with. The types of all the species described by Macleay have been examined, as well as specimens compared with most of Pascoe's types.—T. G. **Sloane**: Descriptions of two new species of Cicindela from Western Australia. One of the two new species proposed is allied to *C. saetigera*, Horn, and is represented by specimens from Lake Austin, near Cue. The types of the other, which is allied to *C. tetragramma*, Chaud., were collected 100 miles north of Kalgoorlie.

BOOKS RECEIVED.

Meteorology in Mysore for 1911. Nineteenth Annual Report. By N. V. Iyengar. Pp. xiv+56+charts. (Bangalore: Government Press.)

Forty-second Annual Report of the Local Government Board, 1912–13. Supplement in Continuation of the Report of the Medical Officer of the Board for 1912–13, containing a Second Report on Infant and Child Mortality, by the Medical Officer of the Board. Pp. vi+411. (London: H.M.S.O.; Wyman and Sons, Ltd.) 2s.

The Face and How to Read It. By A. I. Oppenheim. Pp. 188+plates. (London: F. L. Ballin.) 2s. 6d. net.

The Child and How to Train It. By A. I. Oppenheim. Pp. iii+171. (London: F. L. Ballin.) 2s. 6d. net.

Die Gründung und erste Entwicklung des deutschen Monistenbundes. By Dr. W. Breitenbach. Pp. 109. (Brackwede i.W.: Dr. W. Breitenbach.) 1 mark.

Practical Management of Pure Yeast: the Application and Examination of Brewery, Distillery, and Wine Yeasts. By A. Jörgensen. Translated by R. Grey. Second edition. Pp. 128. (London: *Brewing Trade Review*.) 5s. net.

Transactions of the Royal Society of Edinburgh. Vol. xlix., part 2 (No. 6). Caradocian Cystidea from Girvan. By Dr. F. A. Bather. Pp. 359–529+vi plates. (Edinburgh: R. Grant and Son.) 15s. 6d.

Twenty-eighth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1906–7. Pp. 308+103 plates. (Washington: Government Printing Office.)

Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. xxvi., part 1. Pp. vii+100. (Edinburgh.)

Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. xliii., 1913, January to June. (London: 50 Great Russell Street, W.C.) 15s. net.

Report on the Scientific Results of the *Michael Sars* North Atlantic Deep Sea Expedition, 1910, carried out under the Auspices of the Norwegian Government and the Superintendence of Sir John Murray and Dr. J. Hjort. Vol. iii., part 1. Zoology. (Bergen: Bergen Museum; J. Grieg.) 3l. 10s.

Experimental Science. I., Physics. By S. E. Brown. Pp. viii+272. (Cambridge University Press.) 3s. 6d.

A Galla-English, English-Galla Dictionary. Collected and compiled by E. C. Foot. Pp. vii+118. (Cambridge University Press.) 6s. net.

Proceedings of the Fifth International Congress of Mathematicians (Cambridge, 22–28 August, 1912). Edited by Profs. E. W. Hobson and A. E. H. Love. Vol. i. Pp. 500. Vol. ii. Pp. 657. (Cambridge University Press.) 2 vols., 30s. net.

The State Provision of Sanatoriums. By Dr. S. V. Pearson. Pp. viii+80+iv plans. (Cambridge University Press.) 3s. net.

Rafia Work. By H. C. Walker. Pp. 99. (London and Melbourne: Whitcombe and Tombs, Ltd.) 3s. net.

Who are the Maoris? By A. K. Newman. Pp. 303+plates. (London and Melbourne: Whitcombe and Tombs.) 7s. 6d. net.

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THURSDAY, AUGUST 14, 1913.

MATHEMATICS IN CHINA AND JAPAN.

The Development of Mathematics in China and Japan. By Yoshio Mikami. Pp. x+348. Leipzig: B. G. Teubner; London: Williams and Norgate, 1913.) Price 18 marks.

THE time has not yet come for anything like a complete or final history of mathematics in the Far East; meanwhile Mr. Mikami's work will be welcomed as being practically the first book on the subject accessible to Europeans. Its contents are unavoidably miscellaneous, but there are two or three topics on which some remarks can be made.

First of all we find, as usual, that in the earliest periods there is a special calculating apparatus, which dominates not only methods of computation, but forms of mathematical thought, for many generations. In the case of China this consisted of a board ruled in columns, and a set of calculating sticks or counters. So far we have the equivalent of the abacus; but there is a very important modification, apparently familiar at least as early as 50 B.C. Red counters were used for additive, and black for subtractive numbers, so there was a visible distinction between $+a$ and $-a$ of a most convenient kind.

An abacus does not lend itself to calculation with vulgar fractions, and strangely enough it failed to suggest decimals. However, the Chinese appear to have been in possession of all the rules for working with vulgar fractions as early as the middle or later half of the sixth century, although it was confessed a difficult subject even by learned men. In this respect they were 1000 years or so ahead of Europe. Unfortunately Mr. Mikami does not give any account of the notation (if any) used for fractions at this date.

Approximations to π occupied the attention of many mathematicians both in China and in Japan. Perhaps the most remarkable fact in this connection is that Tsu Ch'ung-chih (A.D. 430–501) calculated π in an Archimedean manner, arriving at upper and lower limits 3·1415927 and 3·1415926. In some unknown way he hit upon the values 22/7 and 355/113, which he called the inaccurate and accurate values respectively. The appearance of this celebrated value 355/113 at so early a date is very remarkable. It may be added that $\pi=\sqrt{10}$ occurs before A.D. 139, and that many Chinese and Japanese have calculated π to a large number of places of decimals.

Another striking thing is that the Chinese seem to have practised Horner's method of solving numerical equations in the thirteenth century (see pp. 74–8). In fact, both Chinese and Japanese constantly use the principles of reversion of series and successive approximation. We can venture to smile at Mr. Mikami's hint that it is "not impossible" that Europeans may have known of the Chinese method; but while doing so we must be careful not to accuse our Eastern kinsmen of borrowing without acknowledgment, unless due evidence is at hand.

There is, in fact, an extraordinary instance of independent discovery, upon which Mr. Mikami makes no remark, but which appears to be absolutely certain, unless somebody has committed an ingenious and elaborate fraud. Early in the nineteenth century Steiner published some extremely elegant results about rings of touching circles (or spheres) touching two given circles (or spheres). His proofs depend partly upon using the method of inversion, so as to change one of the fixed circles (spheres) into a line (plane). Under certain conditions we have a poristic ring of variable touching circles. Now on pp. 238–46 of the present work Mr. Mikami gives a summary of work by the Japanese Ajima Chokuyen, dated 1784, where Steiner's problem for circles is discussed without inversion, and the algebraic conditions are given (in their simplest form) for poristic rings of n circles when $n=3, 4, 5, \ldots 10$: and the method is general enough for the condition to be calculated in any case.

Various problems are given from time to time. Some of these are of a familiar type, and may be of Indian or even Egyptian origin (*e.g.* we have a variation of the sloping reed question). Others, especially of the Japanese, are evidently of native origin—suggested by toys, jugglers' tricks, and so on.

Matters of more general interest are a rule for finding out whether an expected child is to be a boy or a girl, the author's interview with one of the last great Japanese mathematicians of the older school, and lastly the title-page, which is a very significant document. Written in English by a Japanese, the book has been revised by an American professor and published by a German who has probably done more than any of his craft for the spread of scientific literature. The language is that of the lazy lion; the rest belongs to the lands of the two eagles and the rising sun. Let the lion beware lest reflection show him that he has an ass's head.

The reviser, Prof. G. B. Halsted, has shown admirable taste in not converting Mr. Mikami's idiom into standard English. In some cases it is rather difficult to understand the author's explanation of obscure rules and processes; but, on the whole, the impression produced is that the greatest of modern tongues is branching off into a new and picturesque variety, destined to flower in due course as it passes from science to poetry.

G. B. M.

TECHNOLOGICAL CHEMISTRY.

A Dictionary of Applied Chemistry. By Sir Edward Thorpe, C.B., F.R.S. Assisted by Eminent Contributors. Revised and enlarged edition. Vol. iv. Pp. viii + 727. (London: Longmans, Green and Co., 1913.) Price 45*s.* net.

THE fourth volume of Sir Edward Thorpe's well-known "Dictionary of Applied Chemistry" covers subjects ranging from oilstone to soda nitre. Among the longer articles are those dealing with some important oils, paints, opium, oxygen and ozone, paper, paraffin, petroleum, photography, platinum, polarimetry, potassium, pottery, quinones, radio-activity, rubber, saponification, sewage, silicon, silk, silver, smoke, soap, &c.

The first edition of this work has won for itself a well-deserved place in the library of the consulting chemist. A book of this description cannot be reviewed adequately by one writer, even after making due allowance for the omniscience of reviewers generally. Each important subject appears to have been written by a specialist, and accordingly none but a specialist in a particular subject is competent to express an opinion on the merits or demerits of each of the articles. I must say, however, that after reading those subjects in which I myself am more particularly interested, I have formed the opinion that the new edition of the dictionary will supplant the old one, not merely because it brings the subject-matter up-to-date, but also because it is a higher-class production. There seem to be very few misprints, and, without taking up the rôle of a schoolmaster correcting exercises, I must confess that I did not like the phrase "monoatomic chemical reaction" in the article on radio-activity (p. 535)—it is my opinion that "monomolecular," or better, "unimolecular," should have been written.

This dictionary—as perforce all dictionaries—is not likely to be consulted by a specialist in his own particular subject, since the articles are too brief for that; but it will prove exceedingly useful when it is necessary to look up outside subjects, because the main facts and principles are not here befogged with detail, as would be the case if reference were to be made to a comprehensive monograph. The book will also prove very useful for the university or college student of general technological chemistry. It is not easy to name a text-book which covers this ground adequately. Such a text-book could certainly not be properly written by any one man, or indeed, by any half-dozen men. A writer of a general treatise is almost certain to err when he attempts to describe unfamiliar processes by paraphrasing the writings of those who know. Pottery as described in treatises on general chemistry might be cited in illustration. One excellent text-book on chemistry has some eight lines on the subject, and in those eight lines there are five mistakes of fact! A student of technological chemistry working through the special articles in this dictionary has some assurance that the articles are written by men who have first-hand knowledge, and his confidence is accordingly well founded.

J. W. Mellor.

CLIMATOLOGY.

(1) *Das Klima.* By Dr. Eugen Alt. Bücher der Naturwissenschaft herausgegeben von Prof. Siegmund Günther. 12 Band. Pp. 136. (Leipzig: Philipp Reclam, jun.) Price 1.50 marks.

(2) *Aus dem Luftmeer.* Meteorologische Betrachtungen für mittlere und reife Schüler. Von Max Sassenfeld. Pp. iv + 183. (Leipzig und Berlin: B. G. Teubner, 1912.) Price 3 marks.

(3) Contribution a l'Etude des Relations existant entre les Circulations Atmosphériques, l'Electricité Atmosphérique et le Magnétisme Terrestre. By Alfred Vialay. Pp. viii + 203. (Paris: H. Dunod et G. Pinat, 1911.)

(4) *Meteorology: A Text-book on the Weather, the Causes of its Changes, and Weather Forecasting.* For the Student and the General Reader. By Prof. W. I. Milham. Pp. xvi + 549 + 50 charts. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1912.) Price 19*s.* net.

(1) IN this little book Dr. Alt seeks to give an account of the fundamental principles and facts of climate, and its importance in the development of civilisation. The first four sections deal with the methods of climatological research, and with the climatic elements, temperature, wind, rainfall, and humidity in their relations with each other, and their distribution in time and space. In the next two sections the author considers climatic zones, viz., polar, cool temperate, warm temperate, tropical with small rainfall, and tropical with one wet season or two wet seasons. The seventh section is devoted to types of climate, land and sea climate, mountain climate, and after

brief notes on variations of climate, and on climate culture, he concludes with an account of the climate of each of the five continents. The book is well written and arranged, and the author has made discriminating use of recent investigations.

(2) It is a commonplace that men seize upon the exceptional and regard it with especial interest while they let pass unobserved the beautiful and wonderful processes which are taking place every day. Herr Sassenfeld has written his book with the object of stimulating and guiding the youth of Germany in the observation of the recurring phenomena of meteorology, which may be for all, as they are already for some, a source of interest and pure delight.

In fewer than 200 pages the author covers the whole ground of meteorological observation and investigation: he devotes a chapter to the temperature of the upper atmosphere, giving Wagner's results for the temperature at heights of 1, 2, . . 10 km. for January and July, and for the whole year. In a small table he indicates the characteristic lag in annual variation of temperature by showing how the difference between the autumn and spring temperatures increases with altitude. Special attention is given to clouds, and three excellent illustrations of different types are reproduced from photographs lent by Dr. Süring, of Potsdam. Pressure is introduced in the middle of the book, after temperature, water vapour, dew, hoar frost, clouds, and rainfall have been considered. Although pressure is of fundamental importance in the study of meteorological processes, it introduces an idea which is strange to the mind and difficult of apprehension; and it is probably wise to impart some knowledge of the meteorological phenomena which affect human life most directly before seeking to teach the bases of dynamical meteorology. Wind, types of weather, and electrical and optical phenomena are next discussed in turn, and an appendix contains a valuable set of monthly rainfall normals for about forty places. The book is printed in Gothic type.

(3) This is a discursive book which shows that the author has read very widely: he deals with the atmospheric circulation in winter and summer in the northern and summer hemispheres, and shows that he is acquainted with most of the literature on the subject. In the second and third sections he deals with atmospheric electricity and terrestrial magnetism, in which he is equally widely read and up-to-date: he includes, for example, a page on Simpson's results regarding the electricity of rain, and proposes his own interpretation of them. The author disagrees with or disparages a large part of the work in meteorology of men like Ferrel and Helmholtz, but there is no evidence of his ability to succeed in solving the problems in which he concludes their work failed. His book may, however, be very useful for the references which it contains. Many of these are not found in current works, *e.g.* the reference on p. 118 to Beale's observations of the diurnal variation of the barometer in 1666.

(4) Prof. Milham has made an excellent plan for his text-book of meteorology. To each chapter is prefixed a table of headings and subheadings, which indicate the scope of the text: each chapter is followed by sets of questions, of topics for investigation, of practical exercises, and of references to the more recent and directly important works and researches on the special subject of the chapter. The book extends to more than 500 pages of text, in addition to a number of plates reproducing beautiful photographs of clouds, snow-crystals, and other phenomena. It is generally well written and trustworthy, but the author lapses occasionally as when, in describing what the world will be like after the atmosphere has gone and the temperature has fallen below the boiling point of hydrogen, he says: "The constant bombardment by meteors will make life in the open more dangerous than on a modern battlefield." The practical way, in which the United States weather service is regarded, is indicated by the appearance early in the book of "the financial saving caused by the Weather Bureau" as a suitable subject for investigation.

The first part of the book deals with meteorology proper, the atmosphere, its constitution, temperature, and circulation, and with weather offices and their work. In the second part the author treats of climate, of atmospheric optics, acoustics, and electricity, and, what is more novel, but of considerable importance, of floods and river stages, their measurement, characteristics, and prediction, the latter forming, in the United States, a part of the regular work of the weather bureau.

E. G.

THE HABITABILITY OF THE PLANETS.

Are the Planets Inhabited? By E. Walter Maunder. Pp. iv + 166. (London and New York: Harper and Brothers, 1913.) Price 2*s*. 6*d*. net.

THE question discussed in this little book used formerly to be considered in every popular book on astronomy, and it was generally supposed that all the planets were very probably inhabited by some sort of intelligent beings. The progress of astrophysics has thrown a great deal of light on the physical constitution of the planets, and this excellent summary of modern telescope-work, and of the consequences of the heat and light received by the planets and the force of gravity at their surfaces, is therefore most useful. Mercury and the outer planets are easily disposed of, and Mr. Maunder even considers what would be the condition of Jupiter and Saturn if cooled sufficiently to become solid at the surface. The results are not encouraging.

Special interest attaches to Mars, which is therefore discussed in considerable detail. The atmosphere is thinner than that at the top of the Himalayas, and though the maximum temperature is well above the freezing point, water must be normally in the state of ice and cannot be liquid to a depth of more than one or two inches, and that only in the torrid zone and during a few hours each day. Mars is therefore essentially a frozen planet, and the extremes of cold experienced there, not only every year, but every day, far transcend those of our polar regions. If there is any vegetation it must be confined to some hardy forms of a low type, stretches of which may account for the so-called "seas." The polar spots cannot be caused by snow, but only by hoar frost.

In a chapter on the illusions of Mars it is shown that recent observations tend to resolve the canals into disconnected knots of diffused shadings. They are therefore caused by an immense number of minute markings which, when fairly near each other and separately below the limit of distinct vision, appear like lines. Several other illusions of Mars not alluded to by the author were exposed by Johnstone Stoney in his papers on telescopic vision in the *Philosophical Magazine* in 1908.

Venus is thus the only planet left which may be inhabited; but the question hinges altogether on whether the rotation-period is something like that of the earth, or equal to the period of revolution round the sun, which is still uncertain. In the latter case one half of the planet will be scorched and the other half frozen.

OUR BOOKSHELF.

Life in Ancient India in the Age of the Mantras. By P. T. Srinivas Iyengar. Pp. x + 140. (Madras: Srinivasa Varadachari and Co., 1912.)

This little book is a good example of the kind of work which native Indian scholars are competent to undertake. The author wisely leaves to European scholars the comparative study of ancient Hindu beliefs and custom. He has undertaken the more useful, if less ambitious, task of analysing the Vedic Mantras, that is to say, the older collection of hymns, as contrasted with the Brahmanas or ritualistic treatises which supplement them. He brings together in a systematic, readable form the scattered references illustrating belief and custom. On the religious side he quotes the original texts describing the priest and his duties, magic, sacrifice, the fire cult, and the state of the soul after death. In the social department he deals with the king and his nobles, agriculture and other occupations, medicine and surgery, household life, war, sea voyages, amusements, the status of women, and so on. In each case he gives literal translations of the original texts, either made by himself or collected from authoritative versions, with detailed references to the originals. The value of such a collection is obvious, and the work, so far as it goes, has been carefully and judiciously carried out. In a new edition he would do well to replace the extracts in Sanskrit, which is unintelligible to most European anthropologists, by a Latin version in those cases where it is impossible to give an English rendering.

Mr. Srinivas Iyengar proposes, with the help of other scholars, to extend this series through the later periods of Indian history. If these monographs are prepared as carefully as that now before us the series will be welcomed by European students of Hindu beliefs and sociology.

Probleme der physiologischen und pathologischen Chemie. By Dr. Otto von Fürth. 2 Band. Stoffwechsellehre. Pp. xiv + 717. (Leipzig: F. C. W. Vogel, 1913.) Price 23 marks.

The appearance of the second volume of Prof. v. Fürth's important book will be welcomed by all who have profited by reading the first volume. The total work is divided into fifty lectures, twenty-five in each volume. They might just as well have been called chapters, for no teacher could ever give lectures of such portentous length. Those before us treat of the large subject of metabolism, both in health and disease. We therefore not only find a description of the chemistry of nutrition, secretion, gaseous exchanges, and so forth, but large sections are devoted to the consideration of such subjects as diabetes and fever.

The book is fully worthy of its author's eminence in this branch of knowledge, and abundant references to literature occur on every page. The information is admirably up-to-date, and the book can be confidently recommended to advanced students as authoritative and interesting. The interest might have been increased by the insertion of illustrations; even the advanced student will find it difficult, for instance, to grasp the meaning of dissociation curves of hæmoglobin unless these are graphically represented.

Prof. v. Fürth is to be congratulated on the completion of his ambitious task, and his readers will wish it every success. W. D. H.

Practical Management of Pure Yeast. The Application and Examination of Brewery, Distillery, and Wine Yeasts. By Alfred Jörgensen. Translated by R. Grey. Second edition. Pp. 128. (London: *The Brewing Trade Review*, 1913.) Price 5*s*. net.

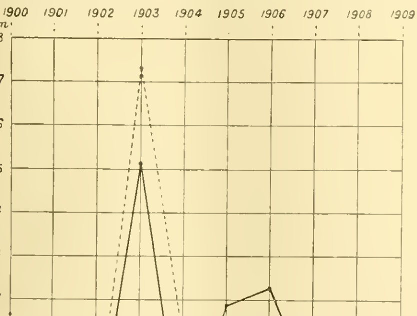
The first edition of this book was reviewed in Nature of November 5, 1903 (vol. lxiv., p. 4). The present issue has been revised and greatly extended by the author, who is director of the Laboratory of Physiology and Technology of Fermentations at Copenhagen. The new work is a remodelling of the first edition, and due regard has been paid throughout to the advancement of this branch of applied science during the last decade. The absence of an index is scarcely compensated for by the somewhat full table of contents.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Variation of Mean Sea-Level.

The many papers which have been written in recent years upon the above subject have dealt chiefly with the now well-known annual fluctuation (first noticed by Lord Kelvin nearly fifty years ago), by which the mean intertidal level of the sea stands on our North Sea and Baltic coasts something like 20 cm. higher in autumn than in spring. But while we still know too little about the details and the causes of this phenomenon, we know much less about the fluctuations of longer period, or even of the elementary facts of correspondence between different coasts in regard to the mean level in successive years.



Mean annual heights of mean sea-level, 1900–9, compared with the mean for the whole period. ------ At Dundee. ——— Mean of fourteen Danish and German ports, after Dr. Brehmer.

A paper published a couple of months ago by Dr. Brehmer, of Hamburg, in the *Annalen der Hydrographie*, gives a valuable set of data for the years 1900 to 1909, drawn from fourteen German and Danish ports, from Bremerhaven to Memel. The results at all these ports are very concordant, and all show a remarkable elevation of mean sea-level in 1903. I had lately been analysing the tide records at Dundee (for the years 1897–1912), and the correspondence of the mean annual values at Dundee with Dr. Brehmer's observations, as the accompanying diagram shows, is so remarkably close as to deserve particular attention. Only between the years 1905–7, and especially in 1906, is there any noteworthy discrepancy.

D'Arcy W. Thompson.

August 1.

On the Transmission of X-Rays through Metals.

When a beam of X-rays is allowed to pass normally through thin rolled metal sheets and fall upon a photographic plate placed behind and parallel to the sheet, some curious patterns are obtained.

These patterns fall into two classes: (*a*), in which the central spot produced by the direct beam is surrounded by an irregular halo of smaller spots, and (*b*), in which the central spot is surrounded by faint extended patches forming a *perfectly symmetrical pattern*. The design varies with the metal.

Class (*a*) markings are given by metal sheets which are either well aged or recently annealed, while the symmetrical patterns of class (*b*) are only obtained with newly rolled sheets. The spots of the former are due to reflections from the microcrystals within the metal, while the symmetrical patterns of the latter are produced by the structure imparted to the metal in passing through the rolls. These star-like patterns are evidently analogous to those obtained when a beam of light passes through a crystal which appears streaky to the naked eye. By annealing a newly rolled sheet the pattern changes from class (*b*) to class (*a*) and *vice versâ*.

It will be of interest to study the nature of the structure which gives rise to the symmetrical patterns.

H. B. Keene.

University of Birmingham, August 7.

A Red-water Phenomenon due to Euglena.

A phenomenon of dichromatism in Euglena precisely similar to that described by Prof. Arthur Dendy in Nature of August 7 was recorded by me in *The Essex Naturalist* in 1890 as occurring at Donyland Heath, near Colchester. During July and August the surface of the largest pond on the heath was almost completely covered with a film which was red in the morning and turned to green in the afternoon. I watched the change take place on August 3 at noon, the transformation taking about half an hour. The omen of blood was viewed with some alarm by the superstitious in the village, and was held to betoken some ill for the community. After the heavy rains of August the pond was quite clear of the film, and no earthquake occurred.

Dr. D. D. Cunningham mentions, in *Science Gossip*, 1886, a similar phenomenon in tanks around Calcutta.

Colchester, August 8. Charles E. Benham.

The Ribbon-Fish.

A specimen of the rare, deep-sea ribbon-fish, *Trachypterus arcticus*, which was landed at the Grimsby market recently, has been sent to me. The following details of the specimen are perhaps worth reporting:—Length, 5 ft. $8\frac{1}{2}$ in.; greatest width, $10\frac{3}{4}$ in. No anal or pelvic fins. Caudal fin not axial, and the ventral portion without fin rays. Base of pectoral fin horizontal. Dorsal fin with 154 smooth rays. Teeth small but sharp. Skin silvery, and spinous on the ventral edge of body and along lateral line. Eye 3 in. in diameter. Lower line of body straight.

F. J. Cole.

University College, Reading, August 2.

THE INTERNATIONAL MEDICAL CONGRESS.

After an interval of thirty-two years, the International Medical Congress returned to London, and was opened at the Albert Hall on August 6 by Prince Arthur of Connaught on behalf of the King. The number of members ran far into the eighth thousand, as compared with 3182 a generation ago. Before this unprecedented assemblage the foreign delegates, whose names are given below, were presented to Prince Arthur, and each said a few words, the fewest and most appreciated, apparently, coming from Dr. Wu, representing the Chinese Republic. After Sir Edward Grey had welcomed the foreign members, Sir Thomas Barlow, the president of the congress, gave his address, which took the form of a retrospect of the progress attained since 1881. The president recalled the supreme names of Pasteur, Lister, Virchow, Huxley, and Koch, remarking that there were giants in those days; but he showed how their pioneer work has been, and is being, followed up by the many devoted workers of our own time. He took occasion, also, to defend vivisectors, especially in this country, from the charges of cruelty and futility commonly brought against them by malice and ignorance.

The general addresses to the congress were delivered on succeeding days by Prof. Chauffard, of Paris, on prognosis in medicine; by Prof. Harvey Cushing, of Harvard, whose discussion of the relation between surgery and medicine was found to contain, as its main feature, the finest defence of experiments on animals that has been heard for many years—a defence supported by the resolution in favour of vivisection which was later passed by the various sections of the congress; by Prof. Ehrlich, of Frankfurt, on pathology nominally, but actually on the most remarkable and beneficent of single achievements in scientific therapeutics that the history of medicine can record; by Prof. W. Bateson, on heredity, a subject which, in his lecture, and in other pathological aspects, received, as was long overdue, much attention at the congress; and by Mr. John Burns, President of the Local Government Board, upon public health. An address on this subject from a determined opponent of vaccination was, perhaps, the most startling novelty of the congress, though the address was well worth hearing, and this aspect of it would fortunately be unknown to most of our foreign guests at the time.

Amid the multitudinous features of the congress, with its hundred or so set discussions and its more than six hundred papers, one subject stands out in clear relief, as would be expected by every reader of Prof. Ehrlich's great address on chemio-therapy, a slightly abbreviated form of which is to be found on p. 620. Those who heard that address were well prepared for the discussion on the duty of the State in regard to syphilis, which was held in the Albert Hall on Saturday at a combined meeting of the sections of dermatology and syphilography, and of forensic medicine, under the presidency of Sir Malcolm Morris, whose initial part in the public advance we have made in the last two or three weeks must be duly honoured by future historians of public health. The result of Saturday's discussion was the unanimous passage of a resolution calling upon the Governments of all countries represented at the congress to make systematic provision for the diagnosis and treatment of all cases of syphilis not otherwise cared for.

Monday's debate on the treatment of syphilis by salvarsan made clear the real significance of the resolution already passed. The reception accorded to Prof. Ehrlich will never be forgotten by those who were privileged to be present. He introduced the discussion, and was followed by Prof. Wassermann, to whom we owe the invaluable blood reaction for the recognition of syphilis, and by Prof. Hata, of Japan, who helped Ehrlich in the great constructive search which led to salvarsan as the six hundred and sixth synthetic compound tested, and now acknowledged to be, as Prof. Wassermann said, "the mightiest weapon in the whole of medicine." Lieutenant Gibbard, R.A.M.C., reported on the revolution wrought by salvarsan in the treatment of syphilis in the British Army, and other speakers, from all parts of the world, whose total experience must run now into scores of thousands of cases, testified to the power of this remedy. Fate has been cruel, indeed, that young Schaudinn, who found the spirochæte only some seven years ago, thus providing Ehrlich with the living object of his chemical genius, should have been struck down in his early thirties, even before the first molecule of salvarsan came into existence upon a planet which the spirochæte has so long ravaged. It need only here be added that, thanks to Schaudinn, Wassermann, and Ehrlich, the whole problem of syphilis is now utterly revolutionised. The medical profession to-day asks only to be allowed to cure the victims of this infection, thereby preventing it as nothing but cure can ever do. The Royal Commission now demanded will be concerned with that central question, "the provision of diagnosis and treatment"; the horrible and useless measures taken in the past can never again be contemplated, and only unteachable ignorance and prejudice against knowledge can excuse the suggestions already made by two members of the House of Commons in this respect.

Another racial poison, alcohol, was the subject of an important discussion on alcohol and degeneracy, in the section of forensic medicine, introduced by Dr. Laquer, of Wiesbaden. The discussion was valuable, but as one-sided as that on the same subject which was held at the International Eugenics Congress last year, for at neither did the distinguished English author of a familiar report on parental alcoholism appear to defend his unique results on this subject.

The debates on various surgical problems, notably the operative treatment of cerebral tumours, excited great interest, and were doubtless profitable. Sir Victor Horsley had a notable reception as a pioneer in this field. But when all credit is accorded to the skill and success of surgeons, we must acknowledge that it will be better to use salvarsan early, which means having ever fewer patients in need of it, than to operate, however skilfully, upon cerebral syphilis; and it will be a great day, certainly, though too slowly approaching, when the principles of "chemiotherapy" can be brought to bear upon the cells of malignant tumours, in the brain and anywhere else. The debate on cancer at the congress was undoubtedly disappointing. Devoted, laborious, and valuable work has been done, very notably by Dr. E. F. Bashford, who was the first reporter upon the subject, and his associates of the Imperial Cancer Research Fund, but the goal is not yet reached. The work of Dr. Freund, of Vienna, who followed him, and who has found substances in malignant cells which are toxic to normal cells, and *vice versâ*, is very promising, and it may be surmised that the views as to specific ferments respectively favouring and disfavouring the chemical processes of the malignant cell, which were advanced by Dr. John Beard, of Edinburgh, some years ago, on the basis of Pasteur's fundamental stereo-chemical discovery, are nearer the line of effective advance than was at the time supposed. Prof. Ehrlich, who worked at cancer in past years, may perhaps return to the subject now and surpass himself. Meanwhile, the results of surgery, and very notably of radium, that astonishing agent, which certainly produces cancer under some conditions, and certainly cures it under others, are very welcome, and improve rapidly every year.

Prof. Simon Flexner could not come, and so we did not hear from his own lips about his work on the ultra-microscopic organism of infantile paralysis. But there was an important debate on "filter-passers," and the time is coming when biology and our views of protoplasm and living matter in general will have to face the strange results of recent research into this subject.

On Wednesday, with a lofty appeal for peace in the name of medical science, from the lips of the president, the congress was brought to a close. Its record, its numbers, its knowledge, have never been equalled, and will most surely and soon be utterly surpassed; but mankind will have ceased to care at all about health and disease, sanity and madness, life and death, before the visit of Prof. Ehrlich, the merciful records and the illimitable promise of his creative genius, at the International Medical Congress of London, 1913, are forgotten, or without homage, wonder, and gratitude remembered. C. W. Saleeby.

The following is the official list of delegates from foreign Governments to the congress:—United States of America, Dr. William Thayer; Austria, Prof. Ritter von Haberler; Argentina, Dr. Eliseo Segura; Belgium, Prof. Heger; Brazil, Prof. Marcos Cavalcanti; China, Dr. Wu; Cuba, Dr. Aristides Agramonte; Denmark, Dr. Madsen; France, M. Landouzy; Germany, His Excellency Prof. v. Schjerning; Guatemala, Dr. Azurdia; Holland, Dr. Rijnberk; Hungary, Prof. Emil de Grosz; Italy, Prof. Bianchi; Japan, Dr. Takamina; Mexico, Dr. Jose Larumbé; Monaco, Dr. Caillaud; Nicaragua, Dr. Alejandro Cesar; Norway, Prof. Dr. Uchermann; Portugal, Dr. Luiz de Freitas Viegas; Russia, General Dr. Rapschewsky; Servia, Dr. Subbotitch; Spain, Dr. Recasius; Switzerland, Prof. Sahli; Sweden, Prof. Essen Möller.

On August 6, in connection with the congress, the Royal College of Surgeons conferred its honorary fellowship upon Prof. R. Bastianelli, Rome; Prof. A. Bier, Berlin; Mr. F. D. Bird, Melbourne; Dr. G. W. Crile, Cleveland, U.S.A.; Dr. Harvey Cushing, Harvard; Dr. von Eiselsberg, Vienna; Dr. E. Fuchs, Vienna; Dr. H. Hartmann, Paris; Prof. W. Korte, Berlin; Dr. W. J. Mayo, Rochester, U.S.A.; Dr. A. Monprofit, Paris; Dr. J. B. Murphy, Chicago; Dr. J. Nicolaysen, Christiania; Dr. F. J. Shepherd, Montreal; and Prof. T. Tuffier, Paris.

At the closing meeting it was announced that the Permanent Commission of the International Congress had unanimously decided to accept the invitation of the Bavarian Government and of the town and University of Munich to hold the next Congress of Medicine in that town in 1917.

The commission further accepted the recommendations of the committees appointed to award the congress prizes as follows:—

(*a*) The Moscow prize, awarded to Prof. Charles Richet, of Paris, for his work on anaphylaxis.

(*b*) The Paris prize, awarded to Prof. A. von Wassermann, of Berlin, for his work on experimental therapy and on immunity.

(*c*) The Hungary prize, awarded to Prof. A. E. Wright, of London, for his work on anaphylaxis.

The committee of the Permanent Commission has been elected as follows:—

President.—Prof. Dr. Friedrich von Müller, of Munich (president-elect for the eighteenth congress).

Vice-Presidents.—M. Calman Müller, of Budapest (president of the sixteenth congress); Sir Thomas Barlow, of London (president of the seventeenth congress).

Secretary-General.—M. H. Burger, of Amsterdam.

Assistant Secretary.—D. Ph. van der Haer, of The Hague.

Member.—M. L. Dejace, of Liège (president of the International Association of the Medical Press).

The following resolutions sent up by the sections of congress will be considered by the commission:—

(A) That, sensible of the ravages wrought by syphilis in the health of the community, and deploring the inadequacy of existing facilities for checking its dissemination, the International Medical Congress calls upon the Governments of all the countries here represented—

(1) To institute a system of confidential notification of the disease to a sanitary authority, wherever such notification does not already obtain.

(2) To make systematic provision for the diagnosis and treatment of all cases of syphilis not otherwise provided for. (Submitted by the combined sections of dermatology and syphilography and of forensic medicine.)

(B) (*a*) That the section is of opinion that beri-beri among natives who live principally on rice is brought about by the continuous and too exclusive use of rice submitted to a too complete milling, which removes the cortical and subcortical layers of the grain.

(*b*) The section urges all authorities charged with the health of native communities to restrain by every means in their power the use of this rice in the dietary of coolies.

(*c*) In view of the proved non-infectiousness of beri-beri the section suggests that all port and sanitary authorities should abolish foreign quarantine and other restrictive measures against this disease.

(*d*) The section resolves that the malady known hitherto under the name of Malta fever shall in future be named "undulant fever." (Submitted by the section of tropical medicine and hygiene.)

(C) That this congress records its conviction that experiments on living animals have proved of the utmost service to medicine in the past, and are indispensable to its future progress. That, accordingly, while strongly deprecating the infliction of unnecessary pain, it is of opinion alike in the interests of man and of animals that it is not desirable to restrict competent persons in the performance of such experiments. (Submitted by various sections.)

THE CONTINUATION OF MILNE'S WORK IN SEISMOLOGY.

A WELL-INFORMED writer in *The Times* of August 7 has insisted on the importance of securing the continuity of the late Prof. Milne's great scheme of seismological observation and research. Milne himself always fought strenuously against his own undertaking being absorbed and lost in any international scheme. It is true that in connection with the international system there are some admirably equipped laboratories, furnished with a variety of instruments of extreme delicacy and sensitiveness; but the establishment of one of these is so costly an undertaking that such laboratories can never become numerous. Milne's aim was to secure a great number of seismological stations, scattered as widely as possible over the globe, each furnished with instruments of the same pattern, the records of which would be strictly comparable. The practical results which have been secured by Milne's scheme have shown that the comparatively simple type of apparatus which he advocated has furnished just such an observational basis for research as is necessary. Milne, at the outset, saw in the British colonies and dependencies the means for a wide extension of his scheme—though he by no means limited his efforts within the Empire. It would, indeed, be a disgrace, as well as a misfortune, to British science if the great undertaking originated by Milne were to suffer dislocation, or to be lost by absorption in any other scheme; and, at the same time, no more worthy monument to Milne's enterprise could be imagined than the maintenance and development of the system of observations to which he devoted his genius and energy, and for which he received little practical encouragement during his lifetime.

It is a very fortunate circumstance that the British Association is holding a meeting so shortly after Milne's lamented death, for no time must be lost if his invaluable organisation is to be rescued from the ruin which is threatened by the loss of its master-spirit. From the year 1841 onward, the association has been the nursing mother of seismological science in this country, and has helped Mallet, and afterwards Milne, by contributions from its funds, and especially by publication of their results. Milne was always ready gratefully to acknowledge the great aid afforded to him by the association, and devoted much of his time during the last year of his life to drawing up a valuable index to the numerous contributions to seismology scattered through seventy-two volumes of the association's reports. This index is now in type, and will be presented at the forthcoming Birmingham meeting. It may be hoped that on this occasion a means may be found for consummating the great aid which the association has always furnished to seismological science, by inaugurating an effort to place Milne's system of observation and research on a sound and permanent basis. It may be suggested that as a national system of meteorological observation has been evolved from the meteorological committees of the British Association, a national seismological scheme may, in like manner, be developed from the association's committees on the subject.

On August 8 a second letter appeared in *The Times* from the president of the Royal Society, strongly urging the importance of continuing Milne's organisation, and making it a national undertaking. Sir Archibald Geikie, besides bearing eloquent testimony to Milne's genius and enthusiasm as a scientific worker and his loveableness as a man, is able to quote from a letter just received from Prince Galitzin, the president of the International Seismological Association, in which it is asserted that Milne "through his most important investigations set seismology on a firm scientific basis, founded upon instrumental observation," that "he can duly be considered as the real founder and promoter of this new and important branch of geophysics," and that the continuation and development of his great work "would be the best monument to his memory." J. W. J.

THE ULTIMA THULE OF POLYNESIA.[1]

EASTER ISLAND, so called because of its discovery by the Dutchman Roggeween on Easter Day, 1722, presents several as yet unanswered problems in ethnology and linguistics. One of these is the provenance of the gigantic stone statues found in the island, another the decipherment of the singular incised tablets which appear to show a form of writing or hieroglyph, though written characters are found nowhere else east of Java. A third problem, the origin and settlement of the present population, or rather of the generation which is now so rapidly passing is less difficult, and is that which Mr. Churchill has set himself the task of investigating in the present volume.

In his former book on the Polynesian wanderings (see NATURE, September 21, 1911, p. 381), the author discussed the entry into the Pacific of the primitive Polynesians, whom he called the proto-Samoans, and their settlement in the region he defined as Nuclear Polynesia, comprising the island-groups surrounding Samoa, and including

[1] "Easter Island. The Rapanui Speech and the Peopling of South-east Polynesia." By William Churchill. Pp. iv+340. (Washington: Carnegie Institution of Washington, 1912.)

the Tonga and Viti clusters, with Rotuma, Uvea, and Fakaafo. He maintains that there was a later migration of the same race, the course of which into Polynesia cannot now be traced. These second comers he calls the Tongafiti, and regards them as having been so long separated from the proto-Samoan that their language had independently and divergently developed. But during the dominance of the Tongafiti in Nuclear Polynesia their speech had become mixed to some extent with the proto-Samoan.

After the expulsion of the Tongafiti from Samoa about the eleventh century of our era, they took refuge in the islands eastward, the Cook and Austral Islands, which became the centre of the migrations which ultimately reached Hawaii and New Zealand. This central region is not dealt with in Mr. Churchill's present work, and he defines the region discussed as "south-east Polynesia," comprising the Paumotu group with Mangareva, the Marquesan and Tahitian groups, and Rapanui or Easter Island.

Mr. Churchill's material for the examination of the languages consists mainly of the vocabularies collected by the French missionaries in Rapanui, the Marquesas, and Tahiti, with Tregear's vocabularies of Paumotu and Mangareva, also derived from French sources. All these lack, as Mr. Churchill notes, the fullness and detail of the Samoan, Tongan, and Maori dictionaries of Pratt, Baker, and Williams, for they start with an original list in French, for which their compilers have sought to ascertain the Polynesian equivalents.

Mr. Churchill's method in the present work is similar to that followed in the "Polynesian Wanderings." After a valuable discussion of the Polynesian alphabet, and of metathesis in Polynesian words, he deals with the sources and variety of Rapanui speech, deducing from its treatment of modern loan-words (European) its principles of deviation from the Polynesian standard. Then, by an examination of the Rapanui vocabulary, he proceeds to distinguish the words which occur (1) in both proto-Samoan and Tongafiti; (2) in proto-Samoan alone; and (3) in Tongafiti only. The first are called general Polynesian. In a table of 957 Rapanui words he refers 436 to general Polynesian, 110 to proto-Samoan (*i.e.* with cognates in Samoan), and 119 to Tongafiti (*i.e.* with cognates in Maori). But 292 words are restricted to south Polynesia alone, that is, have cognates only in Paumotu, Mangareva, the Marquesas, and Tahiti. He states that "the proto-Samoan element represents an older and more primitive type than is shown in the modern languages of Nuclear Polynesia," pointing to the migration from Samoa as having taken place whilst two aspirates were in use, and before the formative elements had been acquired which have enabled the language in Nuclear Polynesia to maintain the final consonant of a closed stem, as in Mr. Churchill's proto-Samoan stem *ikof*, which became *i'ofi* in Samoan and *iko* in Rapanui.

Paumotu is regarded as the "second station of the Tongafiti migration after its expulsion from Samoa, and its centre of distribution to the seats of the present great settlements of this swarm." Mangareva is also dealt with as a centre of distribution, and the Marquesas as affording indications of their being in the fairway of the migration to Hawaii. All these are numerically dealt with, and their words classified as general Polynesian, proto-Samoan, and Tongafiti. A very important result appears in the statement that in the Paumotu vocabulary, whilst 52 per cent. of its words are cognate with the other Polynesian languages, 48 per cent. are found peculiar to Paumotu. Mr. Churchill regards these words as true Polynesian which have gone out of use, as Polynesian words are prone to do, or have been invented to express a new environment, and quotes Dr. Friederici on word-tabu and the theoretical formation of new words. Here two important facts seem to have been lost sight of. In other languages the words used as substitutes for tabu-words are *not* usually new inventions, else they would not be understood by the hearers, but are words really belonging to the languages, though not in general use. Similarly, unless a foreign word is introduced, a new object or action is named by a word already known. In the opinion of the present writer, the fact that the peculiar Paumotu words are totally unlike any others in the island region (except a few in the allied Tahitian) appears to show that they are not Polynesian at all, but rather a remnant of some pre-Polynesian speech.[2]

Mr. Churchill finds in the four languages discussed a wide speech-group of broad diffusion and of considerable complexity. He subdivides this into: (1) a Polynesian speech which has passed from the use and memory of other Polynesians; (2) a later proto-Samoan colony taking refuge from Tongafiti tyranny; (3) a Tongafiti settlement; (4) a migration of associated proto-Samoan and Tongafiti from the west which was caught in the Paumotu chain, only a few stragglers reaching the other groups; (5) from the Paumotus, part of a subsequent migration reached Rapanui, the last home of the Polynesians.

Apart from its theory, with all the interesting issues involved, Mr. Churchill's book has the very practical advantage of presenting in a convenient form Rapanui, Paumotu, Mangarevan, Tahitian, and Marquesan vocabularies, with an extremely useful finding-list in English and Rapanui. The student, whether in accord with Mr. Churchill's theory or not, will find it of much value as a record of the languages.

Sidney H. Ray.

THE SOUTH AFRICAN NATIONAL BOTANIC GARDEN.

THE work of the last session of the Union Parliament included the establishment of a National Botanic Garden at the Cape. This was the natural outcome of the cordial reception given in the House of Assembly to the resolution moved by Sir Lionel Phillips on May 6.

2 Cf. Reports of Cambridge Anthropological Expedition to Torres Straits, vol. iii., p. 519 *et seq.*

Kirstenbosch, the site selected, is peculiarly favourable for the purpose, and affords scope for the development of a singularly beautiful South African garden. It is a farm on the Rhodes estates, to the south of Groote Schur, on the eastern slopes of Table Mountain. It contains the ruins of at least three old homesteads, and was probably occupied very early in the history of the settlement of this portion of the Cape Peninsula. The country seat of Van Riebeek, the first Dutch Governor (1652–1662), adjoins Kirstenbosch on its eastern boundary, and, according to tradition, Van Riebeek obtained from the latter a large supply of native woods for building purposes.

The survey of the Kirstenbosch estate is not yet completed; its area is probably about 400 acres. Of this, the eastern half consists of flat or slightly undulating land, about 200 ft. above sea-level. Above this the western half rises to about 1000 or 1500 ft. The latter includes the lower ends of three richly wooded gorges, in which the native vegetation during recent years has been little interfered with except by occasional fires. The lower-lying parts have been heavily planted with pines (*P. pinaster* and *P. pinea*), oaks, and poplars. Here the native bush has been mostly exterminated. The poplars have completely taken possesion of considerable areas. The oaks, most of which were pollarded many years ago, have been altogether neglected, and now, with few exceptions, are in an advanced state of decay.

The underlying rock, except perhaps in the most elevated parts of the estate, is granite. The slopes, however, are for the most part strewn with blocks of Table Mountain sandstone, fallen from above. Along one edge of the area there is believed to be an outcrop of Malmesbury slates. Many acres are overlain by a rich deposit of humus derived mainly from the oaks and the poplars. The water supply is exceptionally good. Two of the streams from the adjacent gorges, traversing the whole breadth of the estate, are permanent, and a spring, issuing about 200 ft. above the eastern boundary, is perennial. It will therefore be a matter of no great difficulty to irrigate as much of the cultivated land as may be necessary. In the cultivation of South African vegetation the importance of aspect is very considerable. Kirstenbosch offers a choice which is unlimited, save towards the west (where it is shut in by the lower slopes of Table Mountain), and also, of course, there is no direct exposure to the sea. Another factor which calls for careful consideration is that of wind. The well-known Cape South-Easter, which is of frequent occurrence during the season of most active growth and of flowering, has a most injurious effect upon very many species. Owing to the curvature of the Table Mountain range between Mowbray and Muizenberg, and the situation of Kirstenbosch in the curve, the south-east wind rarely reaches it.

Kirstenbosch, therefore, possesses a combination of natural features which make it eminently suitable for the cultivation and study of a very large proportion of the varied floras of South Africa. It already bears several hundreds of species more or less representative of the Cape region itself. Experience already obtained of the cultivation in the Cape Peninsula of dry-climate species from Namaqualand and the central plateau, and of sub-tropical forms from the south-eastern coast belt, affords no room for doubt that many of these also will find a suitable home side by side with the flora of Table Mountain and the adjacent Cape Flats.

The control of the garden is vested in a board of five trustees, to which the following have been nominated by the Government:—Lord de Villiers, Sir David Graaff, Sir Lionel Phillips. Two further nominations are yet to be made, one by the Corporation of Cape Town, and another by the Botanical Society of South Africa, constituted for the purpose of giving general and financial support to the project.

The trustees have made the following appointments:—Hon. director, Prof. H. H. W. Pearson; secretary, Miss H. J. Davison. Plans for a director's residence and a laboratory have been approved. A gardening staff will be appointed immediately.

WIRELESS TIME SIGNALS.

IN the *Annuaire* for 1913 of the Paris Bureau des Longitudes will be found a full account by Commandant Ferrié of the development of wireless time-signalling.

For a long period in the past local time was the only requirement of this kind, until the discovery of America rendered the determination of longitude at sea a matter of great practical importance, thus making the knowledge of the time on a fixed meridian as necessary as that of local time. The growth of railway enterprise in the nineteenth century made the adoption of standard time over large districts an obvious convenience, with the result that different countries adopted their own standard time, and Paris time, for instance, was made legal time throughout France in March, 1891. The subsequent gradual adoption of Greenwich time, or time differing from Greenwich by an exact number of hours or half-hours, has continued until the present time, France, only so recently as March, 1911, substituting Greenwich time for Paris time throughout France and Algeria.

The accurate determination of local time (or Greenwich time altered by a constant) comes into the domain of practical astronomy, and is responsible for a considerable amount of routine work, especially at Government observatories. The difference of longitude between two stations, including, for instance, the "constant" mentioned above, has provided a problem the solution of which has steadily progressed towards accuracy since the invention of the electric telegraph; but for any place not in telegraphic communication with a fixed observatory the greatest stride in advance since the invention of the chronometer has been the application of wireless telegraphy, of which the possibilities began to be considered in this connection very soon after Marconi's first success.

Few unexplored districts of the habitable globe would be beyond the reach of a powerful wireless installation if distributing stations were an ordinary adjunct of every national observatory, and it is likely that the network of stations will be able to distribute Greenwich time over the whole of the oceans.

For general purposes time-determination within a quarter of a second is sufficiently exact, but this accuracy at a fixed observatory was by no means always attainable under old conditions, since a week of cloudy skies, especially if accompanied by considerable changes of temperature, would leave the fixed observatory almost as dependent on the rate of a chronometer as a ship at sea. Here, however, the new development steps in and suggests that, since it is not likely to be cloudy everywhere, the time can be checked by that of an observatory perhaps thousands of miles away; so that no error approaching a second of time need be feared.

This state of things, needless to say, is not yet universal; but there is no doubt about the beginning that has been made. The distributing stations, requiring great electrical power and much more costly and elaborate fittings, will always be comparatively few, but the receiving stations can also take part in the scheme. The Eiffel Tower station sends out the Paris Observatory determination of Greenwich mean midnight, for instance, and this is received, say, at Greenwich with a modest equipment and compared with the Greenwich determination. The difference can be sent without much delay to Paris by post or telegram. When it is remembered that at night, under favourable conditions, signals from the Eiffel Tower have been received at a distance well above 3000 miles (5200 kilometres), it will at once be seen how this device will prevent any accumulation of error due to a spell of bad weather.

But a quarter of a second cannot be regarded as indicating the possible limit of accuracy attainable. By employing clocks with a small difference of rate, coincidences of beat can be noted with great accuracy, the arrangement forming what might be called an acoustic vernier. For example, if two sidereal clocks supposed to be synchronised differ by a small fraction of a second owing to a difference of lag in taking up the current from the control clock, this difference can be readily obtained by comparing each with the same mean solar clock, as the coincidences will occur at a definite interval. An accuracy of one-hundredth of a second (to use a loose, convenient phrase) is not by any means impossible in this way, and Commandant Ferrié suggests one-thousandth of a second as practicable. In this way may be measured not only the lag between the clock beat and the closing of the transmitting circuit, the additional lag before the Hertzian waves actually leave the Eiffel Tower, and the lag at the receiving station, but also the velocity of the waves themselves, which can be measured, he says, with an error of less than 3 per cent., though this velocity nearly reaches 200,000 miles per second.

It is part of the routine of the station to transmit time-signals by night and by day, the latter being followed by a meteorological report giving barometric pressure, direction and force of the wind, and the state of the sea for six stations in and around the Atlantic. Similar work, at times arranged not to interfere with that of the Eiffel Tower, is done at the German station at Norddeich, and other extensions will doubtless follow. Japan, at any rate, has already started an independent system.

Commandant Ferrié's account gives very full mechanical details of each step of the process, and should be of great interest to the growing number of people possessing private wireless installations, some of whom compare their time almost daily with both Eiffel Tower and Norddeich. There is no indication at present of any intention to erect a distributing station at Greenwich, and, as stated above, it may be considered unnecessary, the fortuitous presence of the Eiffel Tower giving Paris a great advantage, as its range goes far beyond the British Isles.

W. W. B.

NOTES.

The exhibition of specimens illustrating the modification of the structure of animals in relation to flight which has been in preparation for many months at the Natural History Museum will be open to the public on Friday, August 15. It occupies the fourth bay on the right of the central hall, and comprises 166 mounted objects and twelve microscopic specimens for the purpose of elucidating the subject in a popular manner. The adaptation of each kind of flying animal for aërial locomotion is explained, and the changes that must have taken place in the structure of the body before the animal could really fly are indicated, and attention is directed to the remarkable fact that the power of flight has been evolved independently in different groups of animals—*e.g.* bats, birds, Pterodactyles, and insects.

The death is announced, in his fifty-first year, of Prof. Edwin Goldmann, honorary professor of surgery in the University of Freiburg i/B. since 1892. Prof. Goldmann's scientific career and work are referred to in an appreciative notice contributed by Prof. Ehrlich to *The Times* of August 13, and here summarised:—As a pupil and friend of the famous pathologist Weigert, he mastered the technique of microscopy completely. In early days he busied himself principally with researches into biochemistry. Here he turned his attention especially to the study of minute vascular changes. And then an inner impulse compelled him to devote himself to the important field of cancer research, and by ingenious experiments to advance our knowledge of this difficult problem. His great work with a large number of instructive illustrations set in a right light the significance of cell division for biology and the spread of cancer; and afforded far-reaching insight into the complicated means of curing tumours. He reached the summit of his work in the last few years, during which he prosecuted his studies, which must be regarded as classical, in the staining of living tissues. Goldmann recognised clearly that if we desire to know and study the functions of the living cell the staining of living tissues offers the most profitable means. There were previously only a few works dating from an older generation, such as those on methylene blue, but they, corresponding to their own time, followed an incomplete technique. Here came in Goldmann's work. He succeeded in discovering a method of carrying out an exact pursuit of *intra vitam* staining in microscopic sections. The staining material, pyrrol blue, possesses the peculiarity of colouring a very special kind of cells which are found in the connective tissue and of making them visible to the eye, while the dye allows certain round granules contained in these cells to show up distinctly and in an intensive blue. Now Goldmann was able with the help of his method completely to clear up the great significance of the function of these cells, and to show that both in normal functions, as, for example, in digestion, and also in the majority of disease derangements, as in the case of tuberculosis and carcinoma, they play a very important part. His last important work also, "Ueber die Vitalfarbung am Centralnervensystem," dealt with that method and arrived at important conclusions concerning the nutrition of the central nervous system and the circulation of the cerebro-spinal fluid.

Prof. H. C. Jones, professor of physical chemistry at the Johns Hopkins University, has been awarded the Edward Longstreth medal of the Franklin Institute of Philadelphia for his work on the nature of solutions.

The inaugural address at the re-opening of the School of Pharmacy in October will, by invitation of the Pharmaceutical Society, be delivered by Dr. F. B. Power, director of the Wellcome Research Laboratories. On the same occasion Dr. Power will be presented with the Hanbury medal.

The Paris correspondent of *The Times* announces that the expedition to Franz Josef Land, under the command of M. Jules de Payer, left Havre on August 10. The object of the expedition is to explore the little-known north-eastern corner of Franz Josef Land, and a programme of scientific work has been prepared. The base will be established in Zichy Land.

Prof. Charles F. Marvin, professor of meteorology to the U.S. Weather Bureau, has been appointed to succeed Mr. Willis L. Moore as chief of that bureau. The new head of the office has been in the Government service since 1884, and is widely known for his important meteorological investigations. It is announced that under the new administration the Weather Bureau will pay greater attention to such weather reports and forecasts as are likely to affect agriculture.

The fifth annual conference of the National Association for the Prevention of Consumption was opened by the Prime Minister at the Central Hall, Westminster, on August 4, Lord Balfour of Burleigh presiding. A considerable portion of the session was occupied with a discussion on tuberculin treatment, in which Dr. H. W. G. Mackenzie, Prof. Sims Woodhead, Prof. Sali, and Dr. Lydia Rabinowitsch took part. On August 5 Sir R. W. Philip delivered an address on the need for coordination of anti-tuberculosis measures, which evoked an interesting discussion.

Official tests of a system of wireless telephony invented by a Japanese electrician, Mr. Torikata, have led to the adoption of the system by the Japanese Government, which has ordered all the shipping companies subsidised by it to install the apparatus on their principal vessels. The instructions have already been followed by the three largest Japanese mail steamship lines, we learn from *The Japan Chronicle* (July 17), with eminently satisfactory results. Patent rights for the invention have been secured in Japan, England, and France, and others are pending in Germany and the United States. It is stated that the present range of audibility of the Japanese system is sixty miles. The advantage claimed for the apparatus over competing systems is its simplicity, it being no more difficult to use than an ordinary telephone.

Asama-yama, the well-known Japanese volcano, has again been displaying great activity. On June 17, reports the Tokyo *Asahi*, an eruption occurred which is believed to be the most violent on record. Dense black clouds rose to a great height above the crater, and two streams of lava poured forth, one flowing towards Rogome Station, on the south, and the other invading the forest in Kita Saku district, on the west. Further eruptions occurred on June 20 and 26. A heavy fall of volcanic ash, lasting three hours, took place on the former date at Takazaki, thirty miles east of the volcano. On June 26 Dr. Omori, the distinguished Japanese seismologist, with a party of assistants, ascended the volcano with the view of investigating the conditions, but found advance beyond the ninth stage impossible. The party retired to the observatory at the base, intending to await a favourable opportunity of reaching the summit. Several cracks appeared in the upper half of the volcano, from which issued volumes of dust and vapour, and there were indications that a new crater is forming.

We announce with regret the death, as the result of an aëroplane accident, of Mr. S. F. Cody, the well-known airman, while flying with a passenger near Aldershot on August 7. The machine the collapse of which caused the accident was the new large biplane which Mr. Cody had built for the purpose of competing in the coming waterplane race round Great Britain. It was as a kite-flyer that Cody first came into prominence. In 1903, after two failures, he all but succeeded in crossing from Calais to Dover in a collapsible 14-ft. boat drawn by a kite. In 1906 the War Office appointed Cody chief instructor in kite-flying. In 1907 he was largely responsible for the engineering work of the Army airship, *Nulli Secundus*. In 1909 he achieved a cross-country flight of forty miles in sixty-three minutes—a record at the time. Cody was born in 1862, and was in his forty-seventh year when he began his experiments with flying machines. At the time of his death he was building a triplane on which he proposed to try to cross the Atlantic.

To the large collection of the contents of "short stone cists" found in the north-east of Scotland, and displayed in the anatomy museum of the University of Aberdeen, there have been added recently the contents of two others. One was found at Ellon, Aberdeenshire, and the other at Burgie, Morayshire. Both cists lay in elevated gravelly situations, with no external marks or monuments to indicate their positions, and had their long axes directed from east to west. Their roofs and walls were composed of large flat stones indigenous to the parts of the country in which they were found, and their floors of a layer of sand in which pebbles were embedded. The Ellon cist measured (inside) 3 ft. 4 in. by 2 ft. 1 in. by 17 in. deep, the Burgie cist 3 ft. by 1 ft. 10 in. by 2 ft. deep. The former cist contained a fully formed male human skeleton, showing characters ordinarily met with in skeletons found in short cists, viz., stature about 5 ft. 5 in., round skull, short broad face, narrow orbits, and rather wide nose. To its right lay the much-decayed remains of the skeleton of a person from fifteen to twenty years of age. In the cist at Burgie were found remains of a fully formed human skeleton, much decomposed, the skull of which had been so injured after the cist had been found that no observations could be made from it. In both cists the skeletons had been buried in a crouching position. An urn of the "drinking-cup" variety and a flint scraper were found in the Ellon cist, but nothing beyond skeletal remains in the Burgie one.

THE special feature of the present summer is the general dullness of the weather, with which is also necessarily associated a persistent low day temperature. Greenwich this year has the least sunny July on record since the registration of sunshine has been established, and although since August opened the weather has been somewhat brighter, still, many days have been very dull. Only one day at Greenwich has had the mean daily temperature in excess of the average from July 1 to August 11, a period of six weeks, and the highest maximum temperature observed is 76°, on July 12. Notwithstanding the cloudy character of the summer, there has been remarkably little rain, and prior to August 9 a drought had occurred in many parts of the British Isles. At Greenwich no rain fell from July 22 to August 6, a period of sixteen days; at Bath there was no rain for seventeen days, and at Nottingham for eighteen days. For the first sixty-eight days of summer from June 1 to August 7 the aggregate rainfall at Kew is 47 per cent. of the average, and at Greenwich 61 per cent. For the corresponding period in other parts of England Bath had only 20 per cent. of the average, Jersey 27 per cent., Nottingham 33 per cent., Liverpool 65 per cent., and Dover 68 per cent. In Scotland Leith had only 32 per cent. of the average rain and Wick 59 per cent., whilst in Ireland Valencia had 57 per cent., and Birr Castle 68 per cent. Rain has now fallen in many parts of the British Isles, but in places the conditions continue dry.

MR. C. ROBINSON, writing from Lancaster, says that while walking along a grassy path near some trees on a dark night he saw, "gleaming out of the darkness at my feet, what might have been a piece of frosted silver reflecting moonlight." Upon picking up the object he found it was a piece of decayed wood, which he took away with him, but was disappointed to find afterwards that the wood had lost its luminosity. The phosphorescence of decaying wood is not an unusual phenomenon, and is frequently due to the mycelium of a fungus which permeates the wood of old tree-trunks, and has the property of emitting light under the same conditions as those of respiration. When the wood is taken away from its natural surroundings, the luminosity disappears because the relations and conditions of life of the fungus are not the same as before.

IN his lecture on the pygmies of New Guinea recently delivered at the Royal Institution, Capt. C. G. Rawling gave a full account of the expedition organised by the Ornithologists' Union, assisted by the Royal Geographical Society, which left England in 1909 to explore the south-west coast of Dutch New Guinea. He sums up the results as follows:—Large and valuable collections of birds, mammals, reptiles, butterflies, and moths, with botanical and ethnographical specimens, have been made; a new and hitherto unknown race of pygmies was discovered, studied, measured, and photographed; a range of mountains, containing the greatest precipice in the world, together with 3000 miles of country, have been surveyed and mapped; new snow mountains and great rivers were found and explored; a long stretch of coast-line was surveyed. This, the longest cross-country journey ever undertaken in Dutch New Guinea, has proved the impossibility of the Mimika River as a line of advance to the snows, and, on the other hand, the value of the great rivers to the east, if an expedition in the same direction is again contemplated.

CERTAIN human bones discovered in 1911 by Mr. Hiram Bingham in gravel near Cuzco, Peru, have been considered to indicate the existence of man in that country between 20,000 and 40,000 years ago. In an article in the July number of *The American Journal of Science*, Mr. G. F. Eaton, who has visited the spot, states that the associated remains are essentially of a modern type, including, as they do, bones of domesticated cattle. He therefore concludes that the bones were buried some time "during the three centuries and a half that have elapsed since the Spaniards brought domestic cattle to Peru." In a second article in the same issue, Mr. H. E. Gregory states that although his investigations on the spot do not definitely disprove the theory of the great age of the bones, yet "the geologic data do not require more than a few hundreds of years as the age of the human remains found in the Cuzco gravels."

IF we may judge from a report on their breeding in that State, published in the Bulletin of the Illinois

State Laboratory of Natural History, vol. ix., art. 7, carp seem much more highly esteemed as food-fishes in those parts of the United States where they have been introduced than in this country. Their greatest enemies are garpike, which attack the young, and a fungus which infests the spawn, and against the ravages of these two foes remedial measures are suggested by Dr. S. A. Forbes in the article cited.

The King has presented to the British Museum (Natural History) a tiger shot by himself in the Nepal tarai during his Majesty's tour in India in the winter of 1911–12. The specimen, which was mounted by Rowland Ward, Ltd., has been placed on exhibition in a special case on the second floor of the building, between the Banks statue and the upper mammal gallery, opposite a portion of the Hume collection of Indian big-game heads. The animal is set up in a partially crouching attitude on artificial groundwork amid real Indian jungle-grass.

According to the sixth annual report (for 1912) of the American Bison Society, the number of pure-blooded bison in the United States and Canada increased during the season 1911–12 from 2760 to 2907 head. At the instigation of the society the U.S. Government has allocated a tract of 15,000 acres in South Dakota and the adjacent States to form an additional bison-preserve. As it includes part of the winter feeding-grounds of the great herds of bison that formerly ranged to the north and north-east, it ought to be admirably suited for the purpose.

In spite of several more or less well-attested instances of such an occurrence, there is a very general tendency to refuse to believe that female mules may occasionally be fertile. A case recorded in *The Field* of August 2, by Mr. G. J. Harvey, Government Veterinary Surgeon at Nicosia, Cyprus, seems, however, to be beyond reasonable doubt. In this instance the mule, which is stated to have given birth to another foal a year previously, was seen by Mr. Harvey in the act of suckling her foal, then two months old. The parent, which stood 13·2 hands, is stated to be the offspring of a she-ass by an unknown sire, and certified to be an undoubted mule.

The brown discoloration and unpleasant flavour acquired by peaches shipped for long distances has been attributed to so-called "ice-scald." That this injury is not a temperature effect is shown by recent experiments by Mr. G. R. Hill (Cornell University Agricultural Experimental Station, Bulletin 330), and evidence is adduced indicating the harmful effect to be due to an accumulation of carbon dioxide within the paper wrapper round the fruit during transit. During the investigations it was found that growing tissues, such as green peaches and germinating wheat, respire more than twice as rapidly aërobically as anaërobically, whilst ripe fruits respire as actively anaërobically as aërobically. Ripe apples lose their colour, texture, and flavour, and assume the qualities of half-baked apples by being kept for a sufficient length of time in oxygen-free gases. The softening of peaches (hydrolysis of pectose) appears to be decreased greatly by carbon dioxide and to a considerable extent by hydrogen and nitrogen; under similar conditions the fruit becomes brownish, and acquires a very bad flavour. Good ventilation and refrigeration, therefore, would appear to be the essential conditions under which this fruit should be stored.

A further report on the Isle of Wight bee disease has been issued as Supplement No. 10 to the Journal of the Board of Agriculture. Of the various sections of the report the first is contributed by Drs. Fantham and Porter, and deals with the life-history of the parasite (*Nosema apis*), with parasite carriers, examination of pollen, honey, and wax, and of certain insects found in hives; the second section, by Dr. Graham-Smith and Mr. Bullamore, describes results of infection experiments with the parasite, the mode of spread, and the means of treatment and prevention. The bacteriology of the disease is reviewed by Dr. Malden, and a summary of the investigations forms the last section. Up to the present no curative measures have been found, but certain preventive measures have yielded satisfactory results. No species of bacteria constantly associated with the disease has been found, and *B. pestiformis apis*, which is frequently in diseased stock, and was at one time thought to be the causal agent, is not pathogenic in pure culture. Bacteria, however, may play an important secondary part in producing the symptoms when the resisting powers have been lowered by the action of Nosema.

Mr. G. Ricchieri has contributed a lengthy summary of recent work on the nature of the earth's interior to the "Miscellanea di Studi" (R. Accad. Scien. Letter. di Milano). The conclusions of mathematicians and hypotheses of mathematicians, seismologists, and geologists are generally given in detail; but an account can scarcely be held complete which refers for the Rev. O. Fisher's views to the article on geology in the ninth edition of the "Encyclopædia Britannica," and omits all reference to the work of Dr. Milne and the deductions of Mr. R. D. Oldham.

In a paper communicated to the R. Accademia dei Lincei, Dr. G. Agamennone describes an interesting spurious earthquake caused by the sudden fall in Rome of a wall 60 metres long, 20 metres high, and 1·25 metres in mean thickness. The resulting shock was sensible to man at a distance of 350 metres, and it was recorded by a seismograph at the Collegio Romano, about 700 metres from the fallen wall. The maximum amplitude of the movement was only 0·005 mm., and this was attained two or three seconds after the beginning; the period of the vibrations was about one-third of a second, whereas in earthquakes of near origin the period is rarely less than one second.

The meteorological charts of the North Atlantic and North Pacific Oceans, issued by the U.S. Weather Bureau, for August, contain instructive articles by Mr. W. E. Hurd on the formation and movements of tropical cyclones. Several physical causes play a prominent part in their formation, but heat and moisture are necessary conditions. Mr. Hurd refers in detail to the works of various investigators, including such well-known names as Viñes, Meldrum, Algué, and others; to the variation of the storms with time and place; to their tracks and rates of progression of the vortices; the whole of which will repay careful perusal. Actual reference is not made to the article on the same subject in the valuable "Barometer Manual" issued by the London Meteorological Office, which epitomises the results of observations and experience extending over many years. A glance at this work, in conjunction with Mr. Hurd's compilation, explains how in either hemisphere the wind travels round the cyclonic centre in a direction contrary to the apparent diurnal course of the sun, the westerly wind being therefore always found in the portion of the whirl nearest to the equator. The average rate of progression (irrespective of the wind-force in the whirl) varies from about 300 miles a day in the West Indies to from fifty to 200 miles in the southern Indian Ocean. Fassig found that in the West Indies the average daily rate further increased after the recurve of the storm.

THE *Ergebnisse der magnetischen Beobachtungen* of the Royal Observatory of Wilhelmshaven for the year 1911, in addition to valuable information about magnetic diurnal and secular variation at Wilhelmshaven, contains an elaborate discussion by Prof. Bidlingmaier of what he calls "die erdmagnetische Aktivität." By "activity" he means a more exact numerical measure of the energy of magnetic forces than is afforded by the present international scale, which assigns 0 to a quiet, 1 to a moderately disturbed, and 2 to a highly disturbed day. Prof. Bidlingmaier's introductory remarks on the theoretical side are of extreme generality, but practically he assumes the "activity" for a given interval of time in a magnetic element to be proportional to the mean square of the differences of its values taken at a large, theoretically infinite, number of equidistant times throughout the interval from the mean value during the interval. By summing the "activities" for three rectangular components one would have a measure of the total "activity." The interval of time may be the hour, the day, or the year. In the first case, in practice, Prof. Bidlingmaier seems to approve of values at six-minute intervals. The labour involved in arriving at hourly "activities" throughout the whole year being very great, an attempt was made to see whether the "activity" in this case could be expressed as a definite function of the range. Hours having the same range were collected in groups, and the corresponding mean measured "activities" were plotted as ordinates of a curve of which the abscissæ were the ranges. A regular curve was thence derived, somewhat resembling part of an hyperbola. The work merits the attention of all interested in magnetic disturbance.

Engineering for August 8 contains an illustrated account of experiments on the distribution of wind velocity in the space surrounding a circular rod in a uniform current of air. These experiments were conducted at East London College by Prof. J. T. Morris. The wind velocity was measured by electrical apparatus. Electrically heated wires were attached to the circular rod, and the cooling of these wires by the air current was used as a measure of the wind velocity. The method has been described already by Prof. Morris at the Dundee meeting of the British Association, and at the recent soirée of the Royal Society. The present article gives complete sets of curves showing the wind velocity at different distances from the rod for various speeds of main air current, together with velocity-contour lines for currents of fifteen and five miles per hour. The "shadow" of the rod is brought out clearly by these graphs, and extends much further at low than at high velocity. Judging from the results, the electrical method of measuring air velocities seems to possess considerable advantages in the field of experimental aërodynamics.

THE foreign commerce and navigation of the United States for the year ending June 30, 1912, is dealt with in a volume prepared by Mr. O. P. Austin, and published at Washington by the Department of Commerce and Labour in the United States. The bulky volume of 1342 pages is concerned almost wholly with statistics, and provides detailed information of every department of the trade of the United States. In the fiscal year 1912 the exports of manufactures from the States were larger than in any earlier year in the record of American commerce, and imports of manufacturers' materials also showed larger totals than in any earlier year except 1910. This increasing share which manufactures form in American exports, and manufacturers' materials form in the imports, is chiefly a development of recent years. Manufactures are supplanting foodstuffs as a leading factor in the export trade of the United States. While the value of foodstuffs exported increased from 1885 to 1900, it has actually declined since that date. The percentage which foodstuffs formed of the total exports has declined steadily since 1880; on the other hand, the percentage of manufactures has as steadily increased.

OUR ASTRONOMICAL COLUMN.

RADIAL VELOCITY OF 915 STARS.—Prof. Campbell publishes in Lick Observatory Bulletin, No. 229, a further valuable contribution to the radial velocities of stars secured with the Mills spectrographs attached to the 36-in. refractor at Mount Hamilton, and with the instruments of the D. O. Mills Expedition at Santiago, Chile. Prof. Campbell states that the results for those brighter stars of classes F, G, K, and M, of which the radial velocities appear to be substantially constant, or the approximate systemic velocities may be estimated, including proper-motion and other auxiliary data, relating to nearly 900 stars, have existed in manuscript form ready for the printer for more than a year. It was proposed to issue them in the form as previously published for the stars classes B and A, but want of funds made such a scheme impossible. Even now the necessary means are not forthcoming, so, to avoid further delay, he publishes them in the briefest form in the present bulletin.

All available results for stars of these spectral classes have been included, whether the observations of the same stars have been published or not in former lists; there are also included velocities for a few stars of classes B and A. Results for a few stars obtained at other observatories are also inserted in the tables. Thus this and all preceding publications make available all the radial velocity results obtained at Mount Hamilton and Santiago up to date, excepting suspected variables and stars the spectra of which contain lines not sufficiently serviceable for measurement. The published lists include, therefore, all stars as bright as the 5·00 visual magnitude in the Revised Harvard Photometry, Annals 50, and, in addition, many hundreds of stars fainter than magnitude 5·00.

STELLAR PARALLAXES.—Prof. Frederick Slocum, in conjunction with Prof. S. A. Mitchell, of Columbia University, publishes in the July number of *The Astrophysical Journal* (vol. xxxviii., No. 1) the results of some stellar parallax determinations from photographs made with the 40-in. refractor of the Yerkes Observatory. The apparatus and methods used were similar in general to those previously described by Prof. Schlesinger, so the communication, to which reference is here made, is limited to the actual results of the investigation. The following table sums up in brief the values determined :—

Star	R.A. (1900) h. m.	Dec. (1900) ° ′	Mag. and spectrum	Relative parallax ″	Probable error ″
ϕ Andromedæ	1 4	+46 43	4·4 B_8	+0·004	±0·008
48 Cassiopeiæ	1 54	+70 25	4·6 A_2	−0·002	0·016
20 Persei	2 47	+37 56	5·7 F	−0·012	0·007
9 Camelopardalis	4 44	+66 10	4·4 B	−0·032	0·011
μ Orionis	5 57	+ 9 39	4·2 A_2	+0·036	0·016
Groningen VII., No. 20.	16 21	+48 35	10·7	+0·125	0·012
Anonymous	17 33	+18 37	9·1	+0·108	0·011
BD 18°3423°	17 34	+18 37	9·0	+0·003	0·004
BD 18°3424°	17 34	+18 37	9·2	+0·003	0·008
96 Herculis	17 58	+20 50	5·5 B	−0·004	0·008
17 Lyræ C	19 4	+32 21	11·3	+0·124	0·008
P Cygni	20 14	+37 43	4·9 B_4P	−0·021	0·016
τ Cygni	21 10	+37 37	3·8 F	+0·006	0·016
Nova Lacertæ	22 32	+52 12	8 to 13 P	+0·007	±0·012

THE BIRMINGHAM MEETING OF THE BRITISH ASSOCIATION.

WE understand that the argument of the presidential address to be delivered by Sir Oliver Lodge at the Birmingham meeting is as follows :—A marked feature of the present scientific era is the discovery of, and interest in, various kinds of atomism, so that continuity seems in danger of being lost sight of. Another tendency is toward comprehensive negative generalisations from a limited point of view. Another is to take refuge in rather vague forms of statement, and to shrink from closer examination of the puzzling and the obscure. Another is to deny the existence of anything which makes no appeal to organs of sense, and no ready response to laboratory experiment.

In his address the president will contend against these tendencies. He will urge a belief in ultimate continuity as essential to science; he regards scientific concentration as an inadequate basis for philosophic generalisation; he believes that obscure phenomena may be expressed simply if properly faced; and he will point out that the non-appearance of anything perfectly uniform and omnipresent is only what should be expected, and is no argument against its real substantial existence.

Since we gave, in NATURE of July 17, summaries of the provisional programmes of most of the sections of the British Association, for the meeting to be held in Birmingham on September 10–17, notes on the forthcoming proceedings of the Engineering Section have reached us. A varied programme of engineering activity will be presented at the meetings of this section, under the presidency of Prof. Kapp, who will deal with electric traction in his opening address. A group of connected papers on the various influences which affect the propagation of electromagnetic waves will be read by Profs. Howe and Marchant and Dr. Eccles. Heat tests of electrical machines will be discussed by Mr. W. R. Cooper, and a practical demonstration of the varied uses of electric cooking appliances will no doubt prove of interest to the members of all sections.

Mechanical engineering claims a large share of the attention of the members, and will include an important paper by Mr. Lanchester, on the application of the internal-combustion engine to railway locomotion, in which he will describe his very successful work in this branch of engineering. Prof. Burstall will discuss the much-debated subject of solid, liquid, and gaseous fuels, and the committee on gaseous explosions will probably present a report on the temperature distribution in the cylinders of internal-combustion engines. A novel hydraulic weighing machine will also be described by Dr. Hele-Shaw, and a new process of bank-note engraving by Mr. Bawtree.

Considerable interest attaches to the report of the new committee for investigating the stress distribution in engineering materials, which will be discussed with the Mathematical and Physical Sections, and connected with this subject Prof. Coker will describe some optical determinations of stress in chain links and in thick cylinders under fluid pressure, Mr. Reid will discuss the flow of plastic solids, Prof. Dixon will deal with impact tests, and Mr. Robertson with the strength of free-ended columns.

Civil engineering is represented by a group of interesting papers, including one by Dr. Cornish on land-slides, accompanied by upheaval in the Culebra cutting of the Panama Canal, while Dr. J. S. Owens and Mr. E. R. Matthews will discuss the movements of sand and shingle in connection with marine engineering work.

A paper of great local interest, by Messrs. Gleadow and Shackle, will describe the fine new station of the Great Western Railway at Snow Hill, while the subject of metals for structures will be discussed by Mr. Walmisley.

The programme of the meeting of Section G is therefore not only of unusual interest, but many of the papers to be read are of considerable importance in relation to industries for which Birmingham is famous.

BONAPARTE RESEARCH FUND GRANTS.

THE committee of the Paris Academy of Sciences appointed to consider the distribution of the Bonaparte Research Fund has made the following recommendations for the year 1913 :—H. Caillol, 3000 francs, for the completion of his work entitled "Catalogue des coléoptères de Provence"; A. Colson, 2000 francs, to enable him to continue his experimental work in physical chemistry; E. Coquidé, 2000 francs, to assist him in carrying out his study of the turf lands of the north of France from the agricultural point of view; C. Schlegel, 2000 francs, to enable him to continue his researches on Crustacean development; Jules Welsch, 2000 francs to assist him in his geological exploration of the coast lines of France and Great Britain, and to extend them to Belgium and Scandinavia; MM. Pitard and Pallary, 6000 francs, equally divided, for their scientific expedition in Morocco, organised by the Société de Géographie; Louis Roule, 2000 francs, for the continuation and extension of his researches on the morphology and biology of the salmon in France; M. Pougnet, 2000 francs, to enable him to continue his researches on the chemical and biological effects of the ultra-violet rays, and for the construction of a quartz apparatus to be used for studying the action of ultra-violet light upon gaseous bodies; M. Dauzère, 2000 francs, for his work on the cellular vortices of Bénard; M. Gard, 2000 francs, for the publication of a work and atlas dealing with the material left by the late M. Bornet; M. Chevalier, 4000 francs, to meet the expenses necessitated by the classification of the botanical material collected in the course of his travels in western and equatorial Africa, and the publication of memoirs on the flora of these regions; Paul Becquerel, 2000 francs, for the continuation of his physiological researches relating to the influence of radio-active substances on the nutrition, reproduction, and variation of some plant species; Le Morvan, 4000 francs, for the completion of his photographic atlas of the moon; M. Pellegrin, 2000 francs, to aid him in the pursuit of his researches, and to publish his work on African fishes, more particularly those of the French colonies; M. Rengade, 3000 francs, for his proposed systematic examination of mineral waters for the presence and distribution of the rare alkaline metals; M. Alluaud, 3000 francs, for facilitating the study and publication of documents collected by M. Jeannel and himself on the alpine flora and fauna of the high mountainous regions of eastern Africa; M. Lormand, 2000 francs, for the purchase of a sufficient quantity of radium bromide to undertake methodical researches on the action of radio-activity on the development of plants; A. Labbé, 2000 francs, for the study of the modifications presented by various animals passing from fresh to salt water or the reverse; de Gironcourt, 3000 francs, for the publication of the results of his scientific expeditions in Morocco and western Africa: M. Legendre, 3000 francs, to assist him in the publication of the maps and documents dealing with his travels in China; H. Abraham, 2000 francs, for the determination, with Commandant Ferrie and M. A. Dufour, of the velocity of propagation of the Hertzian waves between Paris and Toulon.

THE EDUCATION OF EUROPEANS AND EURASIANS IN INDIA.[1]

THE reality of the problem dealt with in the report before us calls for no demonstration. The Hon. Mr. Madge, himself a member of the community, as also of the conference which, at the invitation of the Government of India, met at Simla in July, 1912, was stating a sober fact when he said on that occasion that to his community education was a matter of life and death.

The problem has been said to have two phases, of which one is concerned with the future of the lower stratum of the Eurasian community—the crux of the half-caste question at its worst. The problem in its other phase does not necessarily involve the difficulties inseparable from mixed descent. Undoubtedly every European resident in India is anxious to send his children "home" for at least a part of their education, but there is a substantial and increasing body of Europeans in India who must educate their children there. It is in this body that this phase of the problem centres. Dr. Graham, of Kalimpong, once wrote that one of the saddest experiences was to trace the gradual downcome, generation by generation, of the descendants of men who had helped to build up the British Empire in India.

The more specifically Eurasian problem is clearly not yet solved, for Sir Harcourt Butler, the President, told the conference that according to the best calculation available there were some 7,000 children who were receiving no education, and a Roman Catholic priest stated that there had been recently 134 applications for four vacancies in a Roman Catholic Orphanage. Compulsion was discussed, and, though the President made it quite clear that Government had no present intention of legislating to make attendance at school obligatory—the administrative difficulties involved would be very great—the conference passed a resolution pressing upon Government its opinion that the introduction of compulsory education was necessary to secure that certain classes of the community attended school, adding that it was recognised that this would involve the introduction of free education for all who could not pay fees.

The report shows that the conference realised that the solution of the second of the two phases of the problem lies primarily in the provision of efficient secondary schools, as such institutions are defined in the regulations of the English Board of Education, and now generally understood in this country, but the somewhat nebulous discussion which took place on the grading of schools suggests that those who in India are tackling the problem would be well advised to define more exactly the terms, such as "elementary," "secondary," and "collegiate," which are now becoming current there.

The European schools in India are provided and maintained by the denominations, the local governments assisting with grants and generally supervising the working of the system. This system will, and should, remain, for Government could not possibly undertake the task, and it is a mere waste of time to make vague proposals for Government schools. If, however, there is a danger to which the present system is prone, it is to be found in the tendency to attempt in a considerable number of schools work which could be done more efficiently in a few. The difficulties resulting from this quite natural tendency would decrease if there was less confusion as to the respective functions in the community of the elementary and the secondary school. It may be, as was suggested at the conference, that there is no place in the domiciled community for merely elementary education, though with 7000 children without any education at all this sentiment would seem to savour somewhat of aspiration.

In England we are beginning to appreciate the futility of teaching a child certain rudiments and then at the age of fourteen setting him adrift to find for himself. It is one thing to admit this; it is quite another thing to proceed as if it were within the scope of practical politics that every child should go through a secondary-school course, and to belittle in consequence the function of the school of the higher elementary type. The value to the community of a particular type of school does not depend upon the name by which that type is designated, and as one member of the conference pointed out, no one type of school is really higher than another. If one of the results of the recent Simla conference is the elimination from the minds of managers of the sway of "motives of fictitious prestige," a real advance will have been made.

[1] Report of the Conference on the Education of the Domiciled Community in India, Simla, July, 1912. Pp. iv+202. (Calcutta: Superintendent Government Printing, India.) Price Re. 1 or 1*s.* 6*d.*

THE MOUNT WILSON SOLAR OBSERVATORY.

THE Mount Wilson Observatory received from the Carnegie Institution of Washington the grant of 254,075 dollars, or 50,815*l.*, for the year 1912, for construction investigations and maintenance, and the report of the director shows the magnificent way in which this great sum is being utilised. It is impossible in a short note to give an adequate account of the very admirable report of the director, which covers forty-one pages of very condensed matter. On the first page Mr. Hale modestly states, "among the results of the year's work the following may be mentioned," and then he follows this with brief paragraphs, *thirty-five* in number, each of which is a piece of valuable research work far-reaching in its aim and an important thread in the web which comprises the complete knowledge of stellar distribution and development. Some of the results of these researches have been published in *The Astrophysical Journal*, and received notice in our astronomical column.

The past year has marked the completion of the 150-ft. tower telescope, and great things are expected of it in the future. The work so far done with it has proved that it is perfectly stable and on no occasion has trembling of the image been recorded. It may be mentioned here, and it is not generally understood, that the girder work forming the visible tower is really in duplicate, each girder containing another one inside completely independent of it, and not touching it, and thus forming a complete second but invisible tower. The outside girder work is thus designed to protect the inner one from vibration caused by the wind. The cœlostat and secondary mirror placed at the top of the tower are fixed to a

Fig. 1.—The tower telescope as seen from immediately below, showing the platform and dome at the top.

platform resting on the inner tower. The definition of the solar image is stated to be better than that of the Snow telescope after the early morning hours in consequence of the protection of the beam. In our astronomical column for March 20 a statement was quoted from *The Observatory* for March that the 100-in. mirror, when tested, was found to be probably useless. Mr. Hale, in his report, states that the tests indicate that it may become necessary to discard the disc, but in a footnote adds that "since the above was written. . . . There is now every reason to believe that the present mirror will prove suitable for use in the telescope." It may be that the information in *The Observatory* refers to a further examination subsequent to the footnote. The 60-in. reflector has a very large programme of work allotted

Fig. 2.—The observing house is directly below the tower and above the spectroscopes, which are situated in a deep vertical pit in the mountain.

to it, and mention is made that Prof. Barnard would prefer it for visual work on the planets to any of the large refracting telescopes with which he is familiar. This report will be a revelation to those who work at astrophysics or solar physics this side of the Atlantic, and will probably make some workers very downhearted when they compare their own means of research with those available at Mount Wilson.

CHEMIO-THERAPY.[1]

It must be a great pleasure and a special honour for all of us to meet here personally on British soil for a scientific purpose, in order to take part in the great work which will be of benefit to the whole world. Are we not here in a country that has produced two men who must be considered among the greatest men of all times, Jenner and Lord Lister? Like a star in the darkness of his age, Jenner's great achievement, which broke the power of such an awful public plague as smallpox, still shines with peerless splendour. And on the occasion of the last congress which was held here we gathered with wondering admiration round Lord Lister, who through his introduction of antiseptics brought about a revolution in surgery which stands alone in the history of medicine. Here in England the first example of a modern Institute for Tropical Diseases, which is a model for

[1] From an address delivered before the seventeenth International Congress of Medicine at London on Friday, August 8, by Prof. Paul Ehrlich.

all other institutes of this kind, was created under the direction of Sir Patrick Manson. Through Ross's excellent work, Laveran's discovery of the causes of malaria was so far advanced that entirely new lines were opened up for the hygienic struggle against tropical and subtropical diseases.

The proof by Castellani that a trypanosome is the cause of sleeping sickness, the classical work by Bruce on illnesses caused through trypanosomes, the specific cause of kala-azar (Dum-dum sickness) as proved by Leishman, are all well known to us. The therapeutic influence of atoxyl in the cases of trypanosome diseases was first established in the Liverpool Tropical Institute by Thomas and Breinl, and quite recently Plimmer has brought forward the use of tartar emetic as an effective weapon against protozoal diseases.

The life-work of Almroth Wright is also known to all of us, *i.e.* his work on opsonins and on the prophylactic treatment of typhoid fever, which has been carried out in a practical and most excellent manner. Even these few names, to which I might add many others, show what a high and leading position England has taken and still holds in the fight against infectious diseases. To prevent the spread of and to heal infectious diseases was at all times the highest aim of medical aspirations; however, a systematic pursuit of this purpose has only been possible in recent times, as through the labours of all civilised nations we have got an insight into the nature of infections, the cause of diseases, and the means by which they are transmitted. Through these methods it has been possible to infect animals artificially and so obtain material on which to test the drugs in a systematic and rational manner. From the very first beginnings of therapeutics, chemio-therapy has indeed been in existence, as all the remedies which we employ are chemicals; on the other hand, experimental chemio-therapy could only develop in modern times in a fruitful manner as a result of all this pioneer work. But here also it has been proved that the four most important factors are: patience, skill, luck, and, last but not least, money.

Now, gentlemen, I may perhaps take the liberty of giving you an insight into the workshop of the chemio-therapeutic work. The whole area is governed by a simple, I might even say natural, principle. If the law is true in chemistry that "Corpora non agunt nisi liquida," then for chemio-therapy the principle is true that "Corpora non agunt nisi fixata." When applied to the special case in point this means that parasites are only killed by those materials to which they have a certain relationship, by means of which they are fixed by them. I call such substances "parasitotropic." But I should like immediately to add that there are evident exceptions to this law. So, for instance, we are acquainted with a small series of cases in which the apparent therapeutic results are obtained, although the allied substances in question do not possess parasite-destroying qualities. That is the case in the infiltration of the subcutaneous tissues which is caused by a kind of yeast (sporotrichosis). Here Block proved that the clinically highly therapeutic iodide of potassium first of all dissolves the cells of the infiltration, whilst the parasites, as such, are not in the first instance attacked.

But, in any case, it is safest and best for the development of chemio-therapy not to build on the basis of exceptional work, but it is better to start with such substances as produce the destruction of the parasites by fixation.

Now it has been assumed in different quarters that some of the more modern remedies are incorrectly regarded as parasiticides, but in reality they are not such. Thus, for example, salvarsan or mercury salts are not intended to act directly on the parasites but indirectly, owing to the fact that they excite the organism to the formation of specific anti-substances. This view is based mainly upon the fact that if one mixes the substances in question, such as, for instance, neosalvarsan, with certain pathogenic agents, *e.g.* spirochætes, in test-tubes, one cannot perceive any reduction in their mobility after observing them for hours together. From this fact, which was first discovered by Prof. Hata, the conclusion has been drawn that salvarsan or neosalvarsan, as such, did not in any way directly influence the spirochætes. Now it can very easily be shown that this conclusion is quite incorrect. If, for instance, following Castelli, one suspends the spirochætes of relapsing fever in indifferent mixtures of serum which do not injure their vitality, and if one fills two small tubes therewith and adds to one of the tubes a very small quantity of salvarsan or neosalvarsan, and if one then centrifugalises and then draws off the liquid; if one washes the remaining spirochætes again in a mixture of serum and again centrifugalises it; then one obtains in both tubes a deposit of spirochætes which on microscopic examination shows the same properties, *i.e.* equally good mobility of the spirochætes. If, however, the spirochætes obtained in this manner are injected into test mice, then one can very soon convince oneself that the spirilla treated with salvarsan do not give any infection to the animal, whilst the mice vaccinated with the contents of the control tube promptly shows signs of infection. This proves that salvarsan or neosalvarsan, as the case may be, is absorbed by the spirochætes, and must have damaged them, and that this trace of salvarsan, which is so exceedingly minute that it can scarcely be weighed, was sufficient to prevent the increase of the parasites in the animal body. Therefore, by this very simple and easily intelligible experiment, the direct effect of salvarsan and neosalvarsan on the spirochætes, and thereby the principle of fixation, is absolutely proved; the objection of the indirect effect based upon anti-substances therefore falls to the ground.

It was necessary, however, to penetrate more deeply into the mechanism of this fixation of remedies, and it is only after long-continued efforts that success has been attained in obtaining a clear conception. In order to make practical progress it appeared to be necessary not to be satisfied with the primordial idea, but to see in what manner the drugs are fixed by the parasites, or, as the case may be, by the cells. Only by taking a very roundabout way has it been possible to obtain clearness with respect to these complicated relations, and in this connection it was especially the studies on trypanosomes and especially the investigations of "drug-fast" strains of germs, which led to quite definite representations with regard to the process of fixation. There was no difficulty by continued treatment of the experimental mice with certain definite remedies, *e.g.* fuchsin, in finally obtaining a race of trypanosomes which had become immune against these remedies, *i.e.* "drug-fast," in the case mentioned above immune to fuchsin. There were especially three classes of different remedies which were very suited to this purpose:—

(1) The class of the arsenic compounds, in the following historical order: arsenious acid, arsenilic acid (atoxyl), arsenophenylglycine (salvarsan and neosalvarsan).

(2) The class of the so-called azo-dyes (the trypan red, manufactured by Weinberg, with which Shiga and I made experiments, and the trypan blue of Mesnil).

(3) Certain basic triphenylmethane dyes (fuchsin, methyl violet, &c.).

When a race of trypanosomes has been rendered immune against fuchsin, then this race is immune against all the allies of fuchsin and methyl violet, &c., but it is not immune against the two other classes.

Also a race immune against arsenic compounds is only immune against such, but not against the two other classes. We see, therefore, that the immunity is of a specific nature inasmuch as it is limited to a definite class of chemical substances.

It was just this specific character which indicated that it must be a question of purely chemical processes. Earlier studies relating to another subject, *i.e.* those relating to toxins and antitoxins, pointed to the nature of the said processes. In connection with these it had been shown that the destructive toxins developed their injurious action on the cell by the fact that they are absorbed by certain specific component parts of the cell—side chains—which I have characterised as "receptors," and that the anti-substances represent nothing else than the cell receptors produced in excess under the influence of the toxin and thrown off.

For many reasons I had hesitated about transferring these views relating to receptors to chemical bodies at all, and in this connection it was especially the brilliant investigations by Langley relating to the effects of alkaloids which caused my doubts to disappear and made the existence of chemo-receptors seem probable to me.

From this point of view, the phenomena observed in connection with the "drug-fast" strain of germs can be readily explained experimentally, owing to the fact that the chemo-receptors under the influence of drug-fastness suffer a reduction of their affinity for certain groupings connected with the remedy, which can only be regarded as purely chemical. This reduction in affinity explains in the simplest possible manner why continually increasing quantities of the arsenic compound become necessary for the destruction, *e.g.* of a race of arsenic-fast trypanosomes, for the smaller avidity can only be overcome by a corresponding surplus of the arsenic compound, if the quantity necessary for the destruction of the parasites is to be finally fixed.

We, therefore, come to the conclusion that in the parasites there are present *different specific chemo-receptors*, for instance, the *arseno-receptor*, which fixes the trivalent group of arsenic as such; and the *acetico-receptor*, which fastens to itself the acetic acid group, an *iodine-receptor*, an *orthoamidophenol-receptor*, which conditions the fixation of the salvarsan, and many others in addition. A complete exhaustive knowledge of all the different chemo-receptors of a certain definite parasite is what I should like to characterise as the *therapeutic physiology of the parasite cell*, and this is a *sine quâ non* of any successful chemio-therapeutic treatment. I should like to emphasise the fact that many observations indicate that certain chemo-receptors are due to several different kinds of parasites, not to a single one. The knowledge of these is of special practical importance, because remedies which are adjusted to these have a healing influence on a very large series of the most various pathogenic agents. *The larger the number of different chemo-receptors, therefore, which can be demonstrated the greater is the possibility of a successful chemio-therapy.*

Now if we seek for specific remedies, then the first condition is that they must possess a certain definite grouping, which is chemically allied to one of the chemo-receptors of the parasite. This is only a necessary prior condition of the toxic effect, but in general it is not a sufficient one in itself. Hundreds of substances may fix themselves on a parasite and only a few are capable of bringing about its destruction.

In the therapeutically suitable substance there must, therefore, in addition to the fixing group, which brings about the fixation of the *haptophorae*, be another, which as such brings about the destruction, and therefore is to be characterised as the "poisoning" or *toxophoric*. This representation exactly corresponds to the views which we have already long since obtained with respect to toxins, in which we distinguish the presence of a haptophoric group which conditions the cell fixation and also the formation of the antitoxins, and a toxophoric group which brings about the injurious action on the cell. In the case of the highly complicated synthetic drugs the assumption will have to be made that the haptophoric group and the toxophoric group are not *directly* connected with one another, but as separate groups are linked with a chemical molecule in the character of side-chains. In this way we arrive in a natural manner to this, that chemio-therapeutic agents, built up in a complicated manner, may be compared to a poisoned arrow; the fixing group of the drug which anchors itself to the chemo-receptor of the parasite corresponds to the point of the arrow, the binding member is the shaft, and the poison group is the arrow poison fixed to the shaft of the arrow. Corresponding to this scheme in the case of salvarsan (dioxydiamidoarsenobenzol) the benzol group would correspond to the shaft, the orthoamidophenol group to the point, and the trivalent arsenic group would correspond to the toxophoric group.

If we continue this comparison, then the substances which are used for poisoning the arrows are alkaloids and similar substances, which act injuriously on certain definite vital organs of the body; and so we shall also have to assume that the toxophoric grouping of the synthetic drugs poisons the protoplasm of the bacterial cell, and this only appears to be possible when a chemical affinity exists between the toxophoric grouping and the constituents of the cell. The circumstance that all the derivatives of arsenic which contain arsenic in the pentavalent form, *i.e.* in the fully saturated form, do not bring about any therapeutic action, but that this only commences when the arsenic group exists in the unsaturated condition corresponding to the trivalent radical, certainly points in the same direction. This difference between the saturated and unsaturated arsenic radical was discovered by the master mind of Bunsen, for in the year 1843, in his comparative studies relating to the non-poisonous cacodylic acid with the pentavalent arsenic and its poisonous reduction product, the cacodyl with the trivalent arsenic, he came to the conclusion that "the cacodylic acid had lost the power to form an attacking point, and at the same time it had lost its effect on the organism." In the subsequent period a very large series of analogous cases have become known corresponding to this truth, which point to the increased effectivity of the unsaturated radical. The best-known example is doubtless the high degree of toxic power of carbon monoxide as compared with the almost indifferent carbon dioxide.

Dyes act as bactericides only as such, but not in the form of their colourless products which correspond to the saturated type. *The fact is that all these unsaturated combinations contain unsatisfied avidities which render them capable of reacting additionally with other combinations.*

If, therefore, we poison a spirochæta with salvarsan, then there occur at least two different chemical fixations: first of all the fixation of the orthoamidophenol group, which primarily fixes the salvarsan to the parasite. It is only in consequence of this fixation that secondarily the trivalent arsenic group is given the opportunity of entering into chemical combination with the arseno-receptor of the cell, and so to exert its toxic effect. The avidity of the arseno-receptor can in itself be such that it can only react if favouring factors, which chemically must be regarded as a stereo-chemical facilitation, come into action.

Examples of such stereo-chemical facilitations are frequently found in chemistry, *e.g.* in the chemistry of the ortho-condensations. And so the haptophoric group of the arsenic molecule primarily brings the arsenic along to the cell, and secondarily brings about its possibility of action.

Now, it is a frequent practice of many uncivilised peoples, in order to be certain of killing their enemies, that they not only rub over their arrow with one kind of poison but with two or three totally different kinds of poison. And so it also appeared advisable to imitate this procedure against the parasites, which is otherwise not very praiseworthy, and to poison our synthetically poisoned arrows not singly but doubly. In association with Dr. Karrer I succeeded in depositing the reduced arsenic compound, *e.g.* salvarsan, even on metals, and so in arriving at remedies which, used experimentally on animals, show an increased effect.

In the previous remarks I have described the conditions which are necessary in order that a certain substance may exert a parasiticidal effect, and indeed must effect such, if it operates directly on certain definite parasites in an aqueous solution, such as, for instance, is the case with the ordinary disinfectants. In the manner described above it is easily possible to arrive at a very large number of substances which will destroy bacteria and allied substances in aqueous solutions. But, of course, the problem is much more difficult when it is a question of internal disinfection or of the destruction of living parasites within the infected organism. If the problem is set before us of sterilising a room, then indeed it is an easy matter to do so, owing to the present advancement of science; but the task becomes more difficult when the room is filled up with materials; and when these materials are of such a delicate sensitiveness as living cells, then the difficulty of the problem will be manifest without any further explanation. As a matter of fact, it has proved that substances which bring about a colossal bactericidal effect in aqueous solutions even when they are highly diluted, are totally ineffective in therapeutics properly so called. For it has turned out that, generally speaking, these disinfectants are more or less powerful cell poisons, and seriously injure the organism; they are, therefore, not only parasitotropic but also *organotropic*.

Now, it depends exclusively on the relationship between parasitotropic and organotropic as to whether a certain disinfectant can be used as a remedy. In Robert Koch's celebrated experiment, in which even the largest doses of sublimate did not produce even a trace of therapeutic effect on anthrax infection, it is evident that the parasitotropic effect was reduced to nil by the organotropic effect. If the relationship of organotropic to parasitotropic is somewhat more favourable, then one may observe a peculiar phenomenon, consisting in the course of the infection being rendered worse to an extraordinary degree by the remedy, owing to the effect that the parasites increase to a much greater extent than is generally the case.

This phenomenon, discovered by Hata, is explained by the fact that the ratio of organotropic effect to parasitotropic effect is of such a nature that almost the whole of the poison is absorbed by the organism, but only in infinitesimal quantities by the parasites. According to a biogenetic foundation principle it is quite a common thing for substances which act destructively in *large* quantities to bring about an *increase in the vital functions* in smaller doses. Only such substances, therefore, can be used as therapeutic agents in which the ratio between organotropic effect and parasitotropic effect is a favourable one, and that can be easily ascertained by experiment by a comparison between *dosis toxica* and *dosis tolerata*. *Only such substances can be considered therapeutic agents of which a fraction of the dosis tolerata is sufficient to bring about therapeutic effects.*

The organotropic effect of drugs is, of course, to be attributed, according to the views of Langley and myself, to this, that there are, in the most various cells of the body and its organs, quite different chemoreceptors, exactly in the same manner as we have postulated for the parasites. Apart from the pharmacological effect of the various remedies, this chemical difference of the organs appears clearly in the vital colouring.

I will mention here—in order only to indicate a few examples—the methyl blue colouring of the nerve trunks, the neutral red colouring of the cell granules, and the distribution of the isamine blue in the so-called pyrrol cells, so carefully and excellently investigated by Edwin Goldmann. The pathologico-anatomical findings point also to a chemical divergence on principle. When we see that after the introduction of paraphenylenediamine only the summit of the diaphragm assumes a black colouring; when we see that vinylamine in the case of all kinds of animals isolates and injures the renal papillæ and causes them to die; when after the introduction of cyanosin, as Hata and Goldmann have found, certain definite regions in the hair of mice become coloured, and the colouring matter becomes stored to the greatest degree in the milk glands; when a colouring material of the pyronine series in the case of mice brings about a general dropsy amounting to 50–60 per cent. of the body without injuring the kidney, which doubtless is only to be referred to an alteration of the vessels of the subcutaneous connective tissue, then all these phenomena can only be explained by the fact that at these particular spots definite chemical connections of a specific nature must take place, which must be referred to the presence of certain definite chemoreceptors.

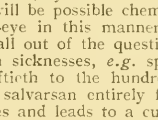
Now, according to the above representations, all these fixations are dependent on the haptophoric grouping of the drugs, and, therefore, it was a matter of great interest to observe how phenylarsenic acid, the mother-substance of the modern arsenic compounds, behaves when various different groups are attached thereto. In this connection it has turned out that when we introduce different constituent fixation groups, *e.g.* chlorine, the oxygen group, the hydrocyanic acid group, the sulphuric acid group, the ammonia radical, we can manufacture, starting out from one substance, a series of combinations, the toxic effect of which may vary fifteen hundredfold. The combinations which are to the greatest extent free from poison—these are derivatives of sulphuric acid, especially the sulpho-phenylarsine acid and its salts—are less toxic than sodium chloride, and, on the other hand, there are substances the very smallest quantity of which brings about death. And in this connection we can see that, according to the nature of the substances, very different organs of the animal's body are injured. Sometimes it is the intestinal tract, and the animals die of profuse diarrhœa; sometimes it is the liver, and the mice—a rare occurrence—become jaundiced and die of serious alterations in the liver; sometimes the red blood corpuscles become dissolved, and the animals die of severe anæmia. Frequently also the central nervous system becomes injured, and in the case of mice this usually relates to the vestibular nerve of the inner ear. The interference with the equilibrium, produced in this way, causes the mice constantly to turn in circles just like the Japanese dancing mice. In the case of human beings the optic nerve is the point of attack for numerous derivatives of phenylarsine acid. The cases of blindness which have been observed after the use of very large doses of atoxyl, arsazetin, and other drugs are due to this injury.

From this it is evident that according to the selection of the group annexed to the phenylarsine acid quite different organs will be affected. This is only explained according to the above views by the fact that there are, as already previously stated, in the various organs specific chemo-receptors which energetically attract certain fixation groups somewhat as the magnet attracts iron. And this view also provides us with the principle *according to which we have to construct our poisoned arrows.* We must attach to the phenylarsine acid group, or, as the case may be, to the phenylarsenobenzol group, such grouping as is only related in a small degree to the organs of the sick body, but, on the other hand, is very closely allied to the receptors of the parasites.

I have explained above that the parasites possess a whole series of chemo-receptors which are specifically different from one another. Now if we can succeed in discovering among them a grouping which has no analogue in the organs of the body, then we should have the possibility of constructing an ideal remedy if we select a haptophoric group which is especially adjusted to the functions of the parasites.

A remedy provided with such a haptophoric group would be entirely innocuous in itself, as it is not fixed by the organs; it would, however, strike the parasites with full intensity, and in this sense it would correspond to the immune productions, the anti-substances discovered by Behring, which, after the manner of the bewitched balls, fly in search of the enemy. Let us hope that it will be possible chemio-therapeutically to hit the bull's-eye in this manner also. I do not consider this at all out of the question, as it may be proved in certain sicknesses, *e.g.* spirillosis in hens, that from the fiftieth to the hundredth part of the *dosis tolerata* of salvarsan entirely frees the animals from the parasites and leads to a cure. Such a dose truly represents a nil dose, as the hen cannot be damaged thereby in the slightest degree. But such favourable conditions have only very rarely been discovered up to the present; we shall have to be satisfied if we can succeed in obtaining good therapeutic results with the tenth or even the fifth or sixth portion of the *dosis tolerata.*

In the main the above are the principles which guided us in the construction of the new remedies. Among the numerous combinations which have been tested in experiments on animals in the case of trypanosomes and spirillar infection, and in the preparation of which I have been supported by the untiring co-operation of Dr. Benda, Dr. Bertheim, Dr. Kahn, and Dr. Karrer, and which have been biologically tested, especially by my respected friend Prof. Hata, and later by Dr. Castelli and Dr. Gonder and Frl. Leupold, salvarsan has proved to be the most efficient, the dioxydiamidoarsenobenzol of the formula.



Here the orthoamidophenol group acts as the conducting and the arsenic group as the toxophoric group.

But now, gentlemen, the step from the laboratory to practice, *i.e.* to the bedside, is an extraordinarily difficult and dangerous one—a step which can only be taken with the greatest care. Its difficulty and danger are in the main based upon two factors:—(1) On the fact that in the case of men there exist so-called idiosyncrasies, forms of supersensitiveness which do not occur in the case of animals; (2) it has been shown that certain illnesses of a constitutional nature can cause a supersensibility.

The treatment of patients is an exceedingly difficult and responsible task, and the clinical pioneers, such as Schreiber, Wechselmann, Iversen, &c., deserve our warmest thanks. They have thrown the first light upon the most important questions (dosology, indications, and counter-indications). From a series of observations, which is now so vast that it can scarcely be surveyed, there has, however, resulted what I might call the "therapeutic tactics," which I should here like briefly to explain.

The *therapia sterilisans magna,* which consists in this, that by means of one or at most two injections the body is freed from the parasites. In experiments on animals, and also in the case of a series of important maladies, this principle can be carried through in a clear and pure manner. Here, therefore, the old therapeutic remedy is applicable: "Frapper fort et frapper vite."

We have to ask ourselves the question, What are the causes which make it possible for a favourable result to be obtained, a result which may be taken as *therapia magna sterilisans,* radical cure of the body by means of a single injection? Typical antibodies can be shown to be produced fairly rapidly by the destruction of parasites, and especially of protozoa. Hence, it is quite evident that this assisting action of the organism ought to be eminently efficacious. For if the medicine has destroyed not the whole of the parasites, but only 95 per cent., and 5 per cent. have resisted its action, then these remaining 5 per cent. are sure to succumb to the influence of the antibodies which are rapidly formed. If this is the case, the *therapia sterilisans magna* is attained. Unfortunately, it has been shown that this salutary process may frequently be minimised considerably owing to the biological properties of the parasites. For it may happen that a part of the parasites which survive the first injection escape destruction by the serum either wholly or in part, and subsequently change into new varieties which have become serum-proof, and are known as a relapsing crop. It is clear that parasites of this kind which are able to form a large number of relapsing crops offer very great difficulties in their treatment, as in this case the auxiliary forces of the body fail to act, so that it is necessary to do one's utmost to destroy the whole of the parasites all at once by means of drugs, as owing to their great power of adaptation a single germ surviving may perhaps be the cause of the infection breaking out afresh.

If we compare the fight against parasitic diseases with a state of warfare, we find that, on one hand, great battles are fought which may lead to victory in the course of one or a few days. In combating bacteria such a victory would compare with *therapia magna sterilisata.* If, on the other hand, a fortress has to be taken, the goal cannot be reached with one single stroke, but it may take months and even years.

The measures employed in connection with a bacteriological siege aim on the whole at rendering the places which are not easily accessible more accessible for the therapeutic agent than is the case under ordinary conditions. On the other hand, however, the greater power of resistance of certain parasites has to be taken into account, and this is a purely chemical question which can only be solved by chemical means. The road leading to its solution which promises the best results is that of combined therapy.

From what has been said it will be seen that combined therapy is best carried out with therapeutic agents which attack entirely different chemo-receptors in the parasites. For instance, it is useless to combine euchsin with its nearest relative, methylviolet; and it is useless to combine therapeutically trypane blue and trypane red, for both attack the same spots in the parasites, but it is necessary to select from each group the most effective substance and then to combine the most suitable representatives of the various types. It is clear that in this manner a simultaneous and varied attack is directed on the parasites, in accordance with the military maxim, "March apart but fight combined."

Combined therapy will in the future conquer an ever-increasing field of action. Thus, for instance, Broden, in the Congo, succeeded in connection with sleeping sickness in the human subject—it is true only in the early stage of this infection, which is so difficult to fight against—in obtaining good results by the combination of salvarsan and two basic colouring matters (trypaflavin and tryparosan) by treatment lasting about a week.

It is precisely in the manifold character of the possibilities of combination that I see a special advantage, and peculiar possibilities of development. When once we are acquainted with the majority of the chemoreceptors of a particular kind of parasite, which will be a long piece of work, occupying many hands and heads, we shall have the most far-reaching possibilities of simultaneous attack by various agencies. And on this account combination therapeutics are also absolutely pluralistic in contrast to antitoxins, which may be said to act rather in one single direction.

And now, gentlemen, may I be permitted to refer to a few practical results? You are all aware that with a number of spirillar diseases the principle of *therapia sterilisans magna* has proved most successful. You are aware that it is possible by one single injection of salvarsan to cure frambœsia (yaws), which is also caused by spirochætes, and is a scourge of the tropics, curing it completely except in rare cases where unimportant relapses occur; this has been shown by the work of Strong, Koch, and Castellani. Thus, in Surinam, a hospital in which more than 300 patients with frambœsia were constantly under treatment was closed and turned to other uses after the introduction of the salvarsan treatment, as one single injection sufficed to cure the disease, and the patients could all be discharged but two. It is to be hoped that in this way it will be possible altogether to extirpate frambœsia.

Exactly the same favourable results have been attained with recurring fever in the human subject, the fever immediately subsidising after the injection of salvarsan, and the patients being cured by one injection. The very rare cases of relapse occasionally occurring are also readily curable.

To continue dealing with salvarsan, in syphilis, which is so closely related to frambœsia, a fair percentage of cures has been obtained in the very first stage of the disease by a single injection of a large dose, but, of course, the abortive cure by intensive treatment is far more certain.

With Vincent's angina and the diseases of the mucous membrane of the mouth, which are caused by spirochætes of the mouth, *therapia sterilisans magna* is possible; in fact, in many cases a mere local application of salvarsan suffices. I may here further mention tertian malaria, in which form, but in this form alone, salvarsan has proved successful, and blastomycosis (Petersen) and the Aleppo boil. As regards diseases of animals which can be cured by one single injection of salvarsan, I might specially mention breast disease of horses, which is of such enormous importance to the military authorities, and lymphangitis epizootica, the African glanders in horses.

Most important are the recent observations of Rogers, who found emetin to be a specific against the very serious amœbic dysentery. And if here it is indeed advisable and necessary to repeat the injections, yet the triumph of therapeutics remains unassailed; it is all one to the patient as to whether *therapia sterilisans* or *sterilisans fractionata* is employed, provided only he is relieved of his sufferings in a harmless manner.

Piroplasmosis also, which exerts a disastrous action, causing serious diseases in cattle and dogs, may, according to the observations of Nuttall, be favourably influenced by a pigment belonging to the class of trypane colouring matters, viz. by trypane blue, which was first composed by Mesnil. As I am informed, the fight against this disease has been taken up in a general manner at Pretoria under the auspices of Theiler. The injections are there performed, not by veterinary surgeons, but by the farmers themselves, and they are glad to save their valuable animals scot-free from this serious disease.

It is indeed easy to understand that the schizomycetes, which in themselves are so much hardier than the tender protozoa and spirochætes, will offer an increased resistance to the attack of drugs. Naturally here, too, there are fine differences, and it is perhaps no accident that the pneumococcus, the protoplasm of which is, of course, most sensitive, should in the course of treatment also have shown itself to be particularly sensitive. (I refer here to the fine researches of Morgenroth in the treatment of laboratory animals infected with the pneumococcus by means of derivatives of quinine, especially ethylhydrocuprin.) But in the case of hardier bacteria, too, such as the *Bacillus typhosus*, the possibility of sterilisation is not beyond hope. The first successful experiments in this sphere were carried out by Conrad on rabbits, and later confirmed and extended by Uhlenhuth and his fellow-workers on this species of animal.

If I briefly allude to the very hopeful experiments of Gräfin Linden, who has endeavoured to influence tuberculous infections favourably by means of combinations of copper and lecithin, and if I add that salvarsan also has been shown to have a beneficial action upon the malignant anthrax-bacillus, and upon that of glanders, and, possibly, upon that of erysipelas, both in animal experiments and occasionally, too, in human cases, then all that we know about the chemiotherapeutics of the specific bacterial diseases has been told, so that it is just in this direction that there lies a wide field still to be worked. This field, important as it is, is still in the very first stages of experimentation.

And if after what has been said we cast a glance over the development of medicine and especially of the fight against infectious diseases, we must recognise that in the last fifty years the most important advances have been made in every direction, advances connected above all with the names of Pasteur, Robert Koch, and von Behring.

On one hand we have the isolation of the pathogenic bacteria, which was made possible really by the Koch method of the solid culture medium, and in which Robert Koch's pupils and fellow-workers, Löffler, Gafftey, Pfeiffer, in the first order, participated; the study of protozoa, which started from Laveran's discovery of the germ of malaria; the discovery by Löffler and Frosch, Roux and Nocard, of the viruses which pass through filters; and the recognition of insects as intermediate hosts and transmitters of infectious diseases, which is connected with the name of Theobald Smith, and has led to the most important consequences.

On the other hand we have the study of the immunity theory which was first inaugurated so brilliantly by Metchnikoff, and received a new impetus from the wonderful discovery of antitoxin by von Behring, through which a wide new field, that of the science of immunity and the investigation of serums, was opened up, on which Pfeiffer, Bordet, Widal, Wassermann, and many others, including myself, have worked with successful result. Some of the most valuable fruits of these labours from a practical point of view have been the diagnosis of diseases first in the form of the Widal-Grüber reaction, and later the Wassermann syphilis-reaction, the importance of which for diagnosis and therapeutics cannot be estimated.

All these discoveries, especially in regard to the ways of spreading diseases on the part of the infecting agencies, have, in accordance with the principle that "Prevention is better than cure," been made good use of in the fight against epidemics and for prophylactic measures, and have brought about an improvement surpassing expectation. In the second place the struggle with diseases which have already broken out has been able to derive advantages from these discoveries, the most wonderful example being the diphtheria serum.

Now that the liability to, and danger of, disease are to a great extent circumscribed, so far as epidemics and many other diseases are concerned, the efforts of chemio-therapeutics are directed so far as possible to fill up the gaps left in this ring, more especially to bring healing to diseases in which the natural powers of the organism are insufficient. And I believe that now when definite and sure foundations have been laid for the scientific principles and the method of chemio-therapeutics, the way is visible before us; not always an easy but yet a practicable way. In the diseases involving protozoa and spirilla extraordinarily favourable results, as I have shown, have already been gained, which can also satisfy far-reaching tests. There are many valuable indications that in a series of other diseases—smallpox, scarlatina, typhus exanthematicus, perhaps also yellow fever, and, above all, infectious diseases caused by invisible germs—the prospects of success are brightening. But in contradistinction to these super-parasites the ordinary or common bacterial diseases (diseases due to the streptococcus and the staphylococcus, coli, typhoid, and dysentery, but, above all, tuberculosis) will still require a hard struggle. Nevertheless, I look forward with full confidence to this development also, and might, without being set down as an optimist, put forward the view that in the next five years we shall have advances of the highest importance to record in this field of research. There are indeed problems which often prove too great for the powers of individuals, and can only be solved by a many-sided effort. Considering the enormous number of chemical combinations which are taken into consideration in a struggle with diseases, it will always be a caprice of chance or fortune or of intuition that decides which investigator gets into his hands the substances which turn out to be the very best materials for fighting the diseases, or the basal substances for the discovery of such. But the chances in favour of finding a real cure, and so of winning the big prize, will naturally rise with the number of those who occupy themselves with the definite problem. It is just at this point, above all, that necessity arises to gather and unite all powers, and here special force attaches to that motto, *Viribus unitis*, which gives guidance in so many other fields; which in so exemplary and fine a way is the foundation of this great International Congress, to which thousands have been drawn from all lands, to give their testimony that in the world of science all national barriers have disappeared.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LEEDS.—The council of the University has accepted with deep regret the resignation of Mr. Roberts Beaumont, professor of textile industries. To mark its sense of the value to the University of his work, extending over a period of thirty-four years, the council has placed on record its high appreciation of the services which, during his long tenure of the professorship, Prof. Beaumont has rendered to the clothworkers' departments of the University, and to technical instruction in the textile industries.

LONDON.—Dr. W. C. McC. Lewis, having been appointed to the chair of physical chemistry in the University of Liverpool, has resigned his office in connection with the department of chemistry at University College. Dr. R. E. Slade has been elected to succeed him as assistant. Dr. Slade was educated in the University of Manchester. In 1909, he was appointed assistant-lecturer in physical and electrochemistry at the University of Liverpool, and was subsequently appointed lecturer-in-charge of the department of physical chemistry.

Dr. A. J. Clark, assistant in the department of pharmacology at University College, has been appointed lecturer in pharmacology at Guy's Hospital Medical School. His successor at University College will be appointed at the beginning of next session.

THE short Education Bill recently introduced into the House of Commons by the President of the Board of Education, which dealt with grants in aid of building, has been dropped for this session, owing to the great pressure of Parliamentary business.

BY the will of the Rev. L. C. Chamberlain, we learn from *Science*, 5000l. is bequeathed to the Smithsonian Institution for its mineralogical collections, and 2000*l*. for its collection of molluscs. There was also bequeathed 1000*l*. to the Academy of Natural Sciences in Philadelphia for increasing and maintaining the Isaac Lea collection of Eocene fossils. These bequests were made for the benefit of the scientific work in which the late Mr. Isaac Lea was interested, Mrs. Chamberlain, his daughter, having inherited the money from him. Mr. Chamberlain also bequeathed 20,000*l*. and his residual estate to the Thessalonica Agricultural and Industrial Institute, Turkey.

THE programme for the session 1913–14 of the department of technology of the City and Guilds of London Institute has now been published by Mr. John Murray. It contains the regulations for the registration, conduct, and inspection of classes, for the examination of candidates in technological subjects, and for the award of teachers' certificates in manual training and domestic subjects. The regulations are in the main the same as those of last year, but the rules respecting the award of full technological certificates have been revised. The passing of examinations in science, and in some cases in art, held by approved schools will be accepted as a qualification for the full certificate. Under certain conditions, candidates from approved schools may be exempted from the examination in the first grade in some subjects in which the examinations are held in more than two grades. In a number of technological subjects the syllabuses have been rearranged and redrafted.

THE Illuminating Engineering Society has issued a preliminary report of the joint committee appointed in 1911 to consider the questions in connection with the artificial lighting of schools. The report appears in *The Illuminating Engineer* for July. The committee was chiefly concerned with the needs of the children. The intensity of illumination necessary in schoolrooms depends on the nature of the work carried out. It is suggested that for ordinary clerical work the minimum illumination measured at any desk where the light is required should not fall below 2 foot-candles—four members of the committee say $2\frac{1}{2}$ foot-candles. For special work, such as stitching with dark materials or that in art classes, a minimum of 4 foot-candles is desirable; and for general illumination in assembly-rooms one foot-candle. As regards blackboard lighting, the committee recommends an illumination on the blackboard about 60 per cent. in excess of that prevailing in the rest of the room. To avoid glare it is recommended that no lamps should come within the solid angle subtended at the eye by the blackboard, and a space 2 ft. above it, unless they are completely screened from the eye by a shade impervious to light. With the same object it is suggested that for text-books intended for the use of young children matt paper, sensibly free from prejudicial reflection, should be employed. The use of light-tinted surroundings which serve to diffuse the light is recommended to avoid inconvenient shadows.

SOCIETIES AND ACADEMIES.

MANCHESTER.

Literary and Philosophical Society, July 22.—Dr. H. **Wilde**: Some new multiple relations of the atomic weights of elementary substances, and the classification and transformations of neon and helium. In several of the author's papers on the origin of elementary substances, published by the society (1878–1906), special attention was directed to the seventh series of his classification, on account of the magnitude and importance of its primary members in the economy of nature, viz. nitrogen, silicon, iron, and gold. Silicon in combination with oxygen constitutes more than half the weight of the earth's crust, and is the principal constituent of glass for all the purposes of civilised life. The policy of several writers in doubling the atomic weights of four of the gaseous members of this series, viz. neon, argon, krypton, and xenon, induced the author to review the multiple relations of the seventh series with the important result (1) that six triads are formed out of the eight principal members of the series, in which the sum of the atomic weights of the extreme members is double the atomic weight of the means, and are all multiples of seven. Triads of atomic weights have been fully recognised by Dumas, Faraday, and other philosophical chemists, as indubitable evidence of community of origin, of transmutation, and important factors in the classification of elementary substances. Radium (as was indicated in Dr. Wilde's tables of elements some years previous to its discovery) is one of the synthetic transformations of helium, and is the next higher member of the series to barium, as was since confirmed by Mme. Curie. Helium is also shown in the author's table of 1878 as the analytic transformation ultimate of radium and other members of the second series of elements. The positions of helium and neon, as the transformation ultimates of the second and seventh series respectively, are further interesting in connection with the recent announcements that these elements have been found in glass vessels and tubes in which they had no previous existence. Assuming the reality of these observations, the phenomena not only admit of explication from Dr. Wilde's classifications, but also account for the discordant results obtained by the experimenters engaged in the research. One of the investigators could only find neon, while others, working independently, found helium alone, and in other cases a mixture of both gases. These results were of sufficient interest to induce the author to ascertain the composition of various glasses used in the arts. The principal and most important constituent of the glasses tabulated by Dr. Wilde is silicon, the transformation ultimate of which is neon. The next important constituents of the glasses are barium, calcium, and lead, all members of the second series of elements, the transformation ultimate of which is helium. The alkali methods, sodium and potassium, are constituents of nearly all glasses, and their transformation ultimates (with others of the first series) will be hydrogen and neon, but without helium. All the silicates of the first and second, and some of other series, are easily vitrified in small quantities in laboratory crucibles. Their spectra can then be examined during electrification in tubes (under suitable conditions of temperature and pressure) for the discovery of new elements and the identification of those already known.

PARIS.

Academy of Sciences, August 4.—M. F. Guyon in the chair.—J. **Boussinesq**: The complete determination, by its partial differential equations, of the problem of slow regularised movement of a heavy liquid mass, in the midst of another fluid mass, indefinite and at rest, and equally incompressible.—G. **Charpy** and A. **Cornu**: The displacement of the critical points of iron by the addition of silicon. Contradictory results on this subject have recently been published by Vigouroux and Baker. Seven alloys have been prepared by the authors from Swedish iron to which increasing quantities of ferro-silicon were added. Complete analyses are given of the seven alloys, the silicon ranging from 0·11 to 6·10 per cent. The critical points were determined by the velocity of cooling method, the curves being recorded automatically with the double Saladin-Le Chatelier galvanometer. The point a_3 vanishes when the silicon reaches 1·5 per cent. The point a_2 remains clear throughout, but each increase of 1 per cent. of silicon lowers the temperature by about 11° C. The temperature of a_1 is slightly raised as the proportion of silicon increases, and tends to disappear when the silicon is more than 5 per cent.—Paul **Vuillemin**: The greening of the wood of the pear-tree. The wood is rendered green by *Helotium aeruginosum* and *H. aeruginascens*, the two species differing in the size of the spores. The name of Chlorosplenium is without systematic value, since several genera have been described under this name which are not closely allied. The colour of the wood is retained indefinitely and has been utilised in the arts.—R. **Gateaux**: Continued and analytical functionals.—Jules **Andrade**: The law of similitude of circular springs.—J **Rey**: A method of testing optical reflectors. The proposed method, which is applicable to all optical systems giving a real or virtual image of a luminous point placed at its focus, is based on a photograph of the image of square mesh wire gauze. The photograph shows not only that there is an imperfection of the surface, but gives the points of the surface the curvature of which is incorrect. Two reproductions of such photographs accompany the paper.—MM. **Massol** and **Faucon**: The absorption of the ultra-violet radiations by some mineral colouring matters in aqueous solution. The various colouring matters studied (potassium ferrocyanide, gold chloride, sulphate of copper, potassium chromate, uranium nitrate, nickel sulphate, chromium sulphate) absorb the ultra-violet radiations unequally. From a quantitative point of view, the absorbing power of synthetic organic colouring matters is much greater than that of the mineral colours.—Daniel **Berthelot** and Henry **Gaudechon**: The rôle of uranium salts as photochemical catalysts.

With the exception of uranium salts, none of the fluorescent and radio-active bodies used had any accelerating effect on photochemical reactions. The accelerating effect of uranium salts is limited to a special class of reactions, those which are produced spontaneously in ultra-violet light. The photocatalyst enables the reaction to proceed in ordinary light.—A. **Damiens**: The products of incomplete reduction of cerium oxide. By the action of a limited quantity of carbon on ceric oxide Sterba obtained a substance described by him as cerium oxycarbide. The reduction of ceric oxide is now shown to give a mixture of Ce_2O_3, CeC, and CeC_2; there is no confirmation of the existence of a definite oxycarbide.—F. **Jadin** and A. **Astruc**: Manganese in drinking water and mineral water. The results of a series of determinations of manganese in the drinking water of eight towns and nine mineral springs. All the latter showed appreciable amounts of manganese varying from 0·09 to 0·20 milligram per litre.—Charles **Nicolle** and E. **Conseil**: An attempt at the experimental reproduction of mumps in the ape.—H. **Pottevin** and H. **Violle**: Experimental cholera in the lower apes.—Jacques **Mawas**: The structure and morphological signification of the comb (*peigne*) of the eye of birds.—M. **Arabu**: The Neogene of the north of the Sea of Marmora.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical series), parts 1 and 2 for 1913, contain the following memoirs communicated to the society:—

December 21, 1912.—F. **Bernstein**: Contributions to mathematical statistics. I., The method of treating incomplete material.—G. **Tamman**: The phase-diagram of water.

January 11, 1913.—A. **Peter**: The diatomaceous flora of southern Hanover, including the Harz, and its distribution in the waters of the region.

January 25.—R. **Wedekind**: Further contributions to the zonal partition of the Upper Devonian.—E. **Perna**: The relations of the Upper Devonian of the Eastern Ural and that of Westphalia and Silesia.

February 8.—G. **Tamman**: The relation of the volume-surface to the polymorphism of water.—B. **Dürken**: The transplantation of young osteoblasts into the orbit of the larval frog.—O. **Wallach**: Researches from the Göttingen University Chemical Laboratory. XXVI., The behaviour of carvoxime and of eucarvoxime towards free hydrogen in the presence of colloidal palladium.

February 22.—M. **Planck**, P. **Debye**, W. **Nernst**, M. von **Smolukowski**, A. **Sommerfeld**, and H. A. **Lorentz**: Preliminary report on the course of lectures on the kinetic theory of matter instituted by the committee of the Wolfkehl foundation.—P. **Hertz**: The statistical mechanics of the spatial "aggregate," and the probability of a given "complexion" (kinetic theory of gases).—H. **Bolza**, M. **Born**, and Th. von **Kármán**: Molecular streams and discontinuity of temperature.—P. **Koebe**: Boundary adaptation in conformal representation.

March 8.—W. **Voigt**: Electric and magnetic double-refraction.—R. **Trümpler**: Determination of fundamental star-places from altitude-transit observations.

BOOKS RECEIVED.

The Official Guide to the Norwich Castle Museum. By the late T. Southwell. Fifth edition, by F. Leney. Pp. 182+plates. (London: Jarrold and Sons.)

Brief Sketch of the Natural History Museum of the University of St. Andrews. By Prof. McIntosh. Pp. 63+xvii plates. (St. Andrews.)

Handbuch der vergleichenden Physiologie. Edited by H. Winterstein. 35 Lief. (Jena: G. Fischer.) 5 marks.

A Text-book of Physics. Edited by A. W. Duff. Third edition, revised. Pp. xvi+686. (London: J. and A. Churchill.) 10*s*. 6*d*. net.

The Volatile Oils. By E. Gildemeister and F. Hoffmann. Second edition, by E. Gildemeister. Translated by E. Kremers. First volume. Pp. xiii+677+2 maps. (London: Longmans and Co.) 20*s*. net.

A Systematic Course of Practical Science for Secondary and other Schools. By A. W. Mason. Book II. Experimental Heat. Pp. vii+162. (London: Rivingtons.) 2*s*. 6*d*. net.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt. Jahrg. 1913. lxiii. Band, 1 Heft. Pp. 206+vii plates. (Vienna: R. Lechner.)

Light, Radiation, and Illumination. Translated from the German of Paul Högner by J. Eck. Pp. xii+88. (London: *The Electrician* Printing and Publishing Co., Ltd.) 6*s*. net.

Brazil in 1912. By J. C. Oakenfull. Pp. viii+498+plates. (London: R. Atkinson.) 5*s*.

The Place of Climatology in Medicine. By Dr. W. Gordon. Pp. 62. (London: H. K. Lewis.) 3*s*. 6*d*. net.

Common British Moths. By A. M. Stewart. Pp. viii+88+15 plates. (London: A. and C. Black.) 1*s*. 6*d*. net.

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THURSDAY, AUGUST 21, 1913.

ETHNOGRAPHY OF NORTHERN NIGERIA.

Hausa Superstitions and Customs: an Introduction to the Folklore and the Folk. By Major A. J. N. Tremearne. Pp. xv – 548 + plates + map. (London: John Bale, Sons, and Danielsson, Ltd., 1913.) Price 21s. net.

IN this book Major Tremearne has provided students of folklore with a feast of tales from Northern Nigeria, and it may be said at once that the material is arranged in such a way as to enable the reader to deduce from the tales themselves a very fair picture of the ethnography of the people amongst whom they were collected. The main portion of the book consists of one hundred stories, each of which is accompanied when necessary by a note on the local variants and on parallel tales in other parts of the world. The stories are preceded by a chapter in which they are analysed, and which contains all that can be deduced from them relative to the manners and customs, the mode of thought, and the beliefs of the Hausa, together with many explanatory passages drawn from the author's own experience and reading. They are followed by notes which explain separate words or incidents in each tale, the existence of each note in a particular story being indicated by a number inserted in the text. The book concludes with two short chapters, on tribal marks and on the Bori dance respectively.

The first, or analytical, section has been carefully prepared, and contains much material which will be of value to anthropologists at large. It can scarcely be studied apart from the tales themselves, and the serious student will find it necessary to read this section carefully both before and after studying the text of the legends. The great majority of the stories were obtained at Jemaan Daroro, in the Nassarawa Province, from five informants, two soldiers, two personal servants, and the head of the leather-workers, and the table of contents indicates the individual responsible for each.

A great feature of this collection is constituted by the number of stories in which animals figure as the chief characters, and, as might be expected, one is continually reminded of "Uncle Remus." The favourite character, however, is not "Brer Rabbit," but the spider (which plays also a very large part in Jamaican folklore). He is invariably shown as the epitome of greed and cunning, and though he sometimes comes to grief, he is generally successful in outwitting the other animals. A less frequent character, though more consistently successful in his trickery, is the jerboa, while the hyæna is the buffoon whose unintelligent greed nearly always lands him (or her) in difficulties. Here we have typified the general morality of the native as expressed in his folklore; cunning and wit are the passports to success, and the man who possesses them to a sufficient degree may be excused dishonesty, cruelty, and greed. The one unpardonable sin is stupidity, though disobedience to the wishes of parents is also usually visited with punishment. It is not, however, low cunning only that is held up for admiration; mental acuteness of a high order is also highly esteemed, and a certain number of stories occur which celebrate judgments of a Solomon-like order. The point lies rather in the fact that there seems little, if any, distinction in the native mind between the two varieties of cleverness.

Many of the stories have their counterparts in other regions of the world; we have our old friend the tar-baby, and a story of the equally familiar "open sesame" type; a cumulative tale, similar to that about the old woman and the pig, is also found, and a whole host of characters, such as many-headed giants, witches (who must be utterly destroyed even to the last drop of blood to prevent their resurrection), half-men (like the Japanese *Ippi*), and so forth.

Etiological tales are disappointingly few; but one interesting example explains the relative positions of the eye and eyebrow. In this is related a contest between a man called "You-are-wiser-than-the-king" and the ruler; the latter chases the former, both assuming a variety of shapes, until finally the king's adversary falls into the eye of an old woman and becomes the pupil, while the king transforms himself into the eyebrow to watch for the other to come out, and thus they remain.

One story, apparently told in all seriousness, is interesting as showing singular deficiency in mental arithmetic. A man dies leaving a fortune of 20,001 cowries. It falls to the lot of the king to divide this among three children, and he is at his wits' end to know how to divide the one cowrie. Finally, the aid of a wise man is called in, and he divides the inheritance piecemeal, finally leaving six cowries, of which he gives two to each and thus solves the extraordinarily difficult problem.

Especially worthy of remark is a very full account of the sign-language current among the Hausa, which is found in the first section of the book, and also the short account of the Bori dance, in which the performer becomes possessed by a definite spirit with a definite name and attributes. This dance is now forbidden.

The book contains a large number of illustrations in half-tone and line. The photographs are of very unequal value, and it would have been better if the author had given some indication in cases where they had been retouched. The line-drawings are better, except those of the tribal marks, the value of which is impaired by over-reduction. The principal criticism, however, that may be brought against the illustrations as a whole is that they have very little organic connection with the text.

PHYSIOLOGICAL PATHOLOGY.

A Text-book of Pathology for Students of Medicine. By Dr. J. George Adami and Dr. John Macrae. Pp. x+759+plates. (London: Macmillan and Co., Ltd., 1912.) Price 25*s.* net.

THE appearance of a text-book of pathology which is intended for the use of medical students, and comprises so many of the admirable features of Prof. Adami's larger work, is a very welcome event. "The Principles of Pathology" has taken its place as the standard work on pathology in the English language, but a system of pathology occupying two large volumes is inevitably beyond the powers of the average student, who is obliged, within a limited space of time, to acquire a reasonable knowledge of the numerous subjects of the final examination. The full and detailed treatment which is accorded to the subject in the larger work is, moreover, unsuited to the student at the outset of his studies in pathology. In spite of the authors' claim that the new book is no mere epitome, we are glad to recognise in an abbreviated form many of the best features of the larger work. The articles on inflammation and on the general pathology of tumours are instances in point.

To the student who has received a sound training in the general principles of the biological sciences this book will make a direct appeal. To the medical student the study of pathology should form the natural sequence to the study of chemistry, of physics, of physiology, and anatomy. A work in pathology should be no mere catalogue of the morbid changes in various organs. The student who has been taught to base his views on conclusions to be drawn from experimental facts will find this method of teaching continued and exemplified in this text-book of pathology. The sections which deal with general pathology are written in a most attractive manner, and afford a delightful introduction to the subject. The portion of the work devoted to special pathology is of necessity somewhat brief. Such omissions as occur will, however, be readily filled by the knowledge derived from a practical experience of the subject.

The essential object of this work is, we imagine, to afford an introduction to the subject. This object has been successfully attained. To those who merely seek a compressed epitome of morbid anatomy this book is entirely unsuitable.

H. R. DEAN.

VEGETABLE ALKALOIDS.

The Plant Alkaloids. By Dr. T. A. Henry. Pp. vii+466. (London: J. and A. Churchill, 1913.) Price 18*s.* net.

THE alkaloids of plants have long offered a most interesting and attractive, if always difficult, field of research to both chemists and physiologists. The subtle chemistry of the vegetable cell evolves no objects more fascinating to study than these "vegetable alkalis," as Sertürner first termed them; bodies usually of highly complex chemical structure, and often of appalling potency in their physiological effects. Of the problems which they offer, one in particular—that of their chemical constitution—has received a large amount of attention during the last two or three decades, and much progress has been made with it. *How* much is perhaps scarcely realised until the results are collected and collated, as in the book under notice, in such fashion that a bird's-eye view of the whole field can be readily obtained. Then the reader notes that "alkaloids of unknown constitution" form only one group out of nine, and that group not a remarkably large one; whilst in the case of several members even of this group—for example, the aconites, colchicum, and ergot—knowledge of their structure is beginning to accumulate.

When, however, the chemical structure of an alkaloid has been elucidated, there yet remains a problem of great general importance, namely, how its chemical constitution is correlated with its action on the animal system. What is the deft arrangement of atoms which confers upon strychnine its tetanising action, convulsing all the muscles of the body; and what, on the other hand, is the arrangement in curare, a drug which paralyses the motor nerve endings without affecting the excitability of muscle? Many useful observations have been made on this question, but the difficulties are great, and progress slow. A comparatively simple case is quoted where two investigators, after studying the relation between the mydriatic action and the chemical constitution of the tropeïnes, were forced to the conclusion that no generalisation could be made which would explain all the results they obtained.

Another question which has been much debated is the mode of formation of the alkaloids in the plants. The view mostly favoured is that they, or at least some of them, are decomposition-products of proteins, chlorophyll, and other complex substances. As regards their function in the plants, they have been variously considered as nutrient materials, protective substances, or end-products of metabolism, rendered harmless to the plant, and stored chiefly in special cells whence they are not readily re-absorbed into the active plant tissues.

On these and other general questions Dr. Henry touches, though but lightly, in the introduction to the work under review. It is rather a pity that more space was not given to this aspect of the subject: the one criticism which the book invites is that it is too much like a collection of extracts from the Journal of the Chemical Society. But it is a good collection, and includes the chief historical, chemical, physical, and physiological data relating to the numerous alkaloids dealt with; whilst in the case of those which have been successfully studied, a concise summary is given of the experimental evidence, and of the arguments founded on this evidence, which elucidate their structure and establish their accepted chemical formulæ. In particular, readers whose business or pleasure it is to study the less-known alkaloids will often be moved to call down a benediction on the head of the author.

C. Simmonds.

RECENT BOOKS ON PHYSICS.

(1) *Introductory Electricity and Magnetism.* By Carl W. Hansel. Pp. xv+373. (London: W. Heinemann, 1913.) Price 2*s.* 6*d.* net.

(2) *Mathematical Physics.* Vol. i. Electricity and Magnetism. By C. W. C. Barlow. Pp. vii+312. (London: W. B. Clive, 1913.) Price 4*s.* 6*d.*

(3) *La Matière: Sa Vie et ses Transformations.* By Prof. Louis Houllevigue. Préface de Ed. Bouty. Pp. xxxii+318. (Paris: Librairie Armand Colin, 1913.) Price 3.50 francs.

(4) *Dispersion und Absorption des Lichtes in ruhenden isotropen Körpern.* Theorie und ihre Folgerungen. By Dr. D. A. Goldhammer. Pp. vi+144. (Leipzig and Berlin: B. G. Teubner, 1913.) Price 3.60 marks.

(5) *Cours de Physique Générale.* Leçons professées à la Faculté des Sciences de l'Université de Lille. By H. Ollivier. Tome Second. Thermodynamique et Etude de l'Energie Rayonnante. Pp. 295. (Paris: A. Hermann et Fils, 1913.) Price 10 francs.

(1) THIS book is intended for beginners, but covers the syllabus of the lower certificate examination of the Board of Education. The order of treatment adopted is:—magnetism, electrostatics, current electricity. Each branch is introduced by a simple qualitative account before the more advanced quantitative aspects are considered.

The treatment of the electrostatics is most lucid, and the author makes, and rightly, a special plea for more experimental work, performed by the student himself, in this part of the subject. A number of qualitative experiments are suggested, several of which could be made roughly quantitative, even without the spherical condenser, charged to a known potential, which Mr. Hansel desires installed in every laboratory.

There is very little fault to be found: too much stress is laid on the experimental verification of the inverse square law with very long magnets; an elementary account of the Cavendish proof of the same law should be given in electrostatics, and an account of the kathode rays and allied phenomena would increase the utility of the book for many students.

Each chapter contains a number of questions, the numerical answers being given at the end. The diagrams, if in some cases rather crude, are clear, and have not been stinted. Anyone seeking a class-book in elementary electricity will scarcely better this.

(2) A complete account of the subject to the standard of the pass degree is given in this, the latest issue from the University Tutorial Press; but the descriptive portions are necessarily reduced to the mere outline required to make the mathematics intelligible. Selected portions will be found helpful by all preparing for examinations in electricity, whether of intermediate or honours standard.

The author's aim is to equip the man already familiar with the elements, so that he may read the advanced treatises with understanding, and at the same time to give him that precision of thought which can only be obtained by working numerical examples. The mathematics involved is of a very simple character, a very slight knowledge of the calculus being required for the chapters on condensers and induced currents.

The last chapter contains a summary of the corpuscular theory, marred by one unfortunate statement. On p. 296 we find: "Practically the whole inertia of the atom is supposed to belong to its negative corpuscles. Of these there are roughly 1800 in the case of a hydrogen atom." Later: "These ideas must not be regarded as facts." True, but they should at least represent the current notions of the subject.

(3) Prof. Houllevigue has collected under this title a set of twelve essays dealing, in a semi-popular fashion, with some modern aspects of

physics and chemistry. In the course of his introduction M. Ed. Bouty pays high tribute to the author's skill as an exponent of popular science, and it must be admitted that the anticipations so raised are not disappointed, for the explanations are clear, the analogies happily chosen, and the whole is written in a bright and interesting fashion.

Among the subjects dealt with are "L'ultramicroscopie" and "Le Mouvement Browien," "L'état colloïdal et la vie," "Le cycle de l'azote," and "Les Terres Rares." This last includes an interesting account of the applications of the so-called rare elements, and justifies to a considerable extent the dictum that "the only really rare bodies are those for which no practical applications are known."

(4) Prof. Goldhammer chooses as the basis of his treatment of dispersion that particular form of the theory first advanced in 1902 by M. Planck. In this book the theory is generalised and extended to conducting media with more than one absorption band. An investigation, in vectorial notation, of the vibration of Planck's resonator—the "Electrische Dipole" is followed by the development of the theory in terms of this body. The theoretical results are then compared with the experimental data: gases and vapours, solutions, metals and various compounds all being considered. This portion of the book is especially commendable, being fully illustrated with tables of data and curves.

In the last chapter dispersion is considered from the point of view of the electron theory, the author, following J. J. Thomson, making no distinction between the bound and free electrons. It is concluded finally that, so far, this generalisation of Planck's theory is nowhere in antagonism with the results obtained by experiment. An excellent little treatise, being a notable addition to the literature of the subject.

(5) This is the second volume of a complete course of physics based on the notes of lectures delivered at the University of Lille. The work is to be completed in three volumes, of which the first and third are still in the press.

The thermodynamics is treated mathematically on the usual lines, a knowledge of partial differential coefficients being assumed. The ground covered is extensive, and the treatment rather uneven. For example, thermodynamic potential is dismissed in a single page, and the study of the solid state in a chapter of three pages, while, on the other hand, the section on univariant systems is particularly good. Interspersed in the text are a number of worked numerical examples.

Radiation is treated descriptively on modern lines, mathematical formulæ only being given. Nearly a third of this part of the book is devoted to the astrophysical aspects of the subject: an interesting section, but only inserted at the expense of the rest of the subject.

OUR BOOKSHELF.

Les Pyrénées Méditerranéennes, Etude de géographie biologique. By Prof. M. Sorre. Pp. 508 + xi plates, 41 figures and a map. (Paris: Armand Colin. 1913.) Price 12 francs.

THIS book is not the outcome of a wholly new method of inquiry, but it is a more complete examination of local influences, past and present, acting in a defined area, than most works of a similar nature. The subject is treated historically, especially in relation to man's activity, from the earliest times, in altering or modifying the aspects and composition of the vegetation and in the development of animal life, in relation to advancing civilisation. It is a consolidation of knowledge obtained by workers in the various branches of research connected with life, animal and vegetable, and physical conditions.

The area under consideration comprises the eastern part of the Pyrenees from Andorra in the west and the whole of the low mountains, hills and plains falling therefrom to the east and to the south, to the sea. There are altitudes of nearly 10,000 feet, and the essentially alpine vegetation begins at about 8000 feet. Phytogeography plays an important part in the history of the human race and naturally occupies a large place in this book, where the results of Prof. Ch. Flahaut's investigations are largely drawn upon. The map shows the distribution of the characteristic trees of the successive zones, beginning with the purely littoral vegetation and followed by the evergreen oak and olive, the stone pine, the cork oak, hairy oak, beech, silver fir, Scotch pine, mountain pine, and the alpine zone.

The plates mostly illustrate *paysages* or scenery, and the figures physical conditions and phenomena. An idea of the arrangement of the matter may be obtained from the headings of the chapters:—I. Les Paysages. II. Le sol et les formes du Relief. III. Climat. IV. Les Eaux. V. Les formes de la Végétation Spontanée; and VI. to VII. Les Genres de Vie of the different regions, with a final chapter on La Vie de relations, son influence sur la Vie locale. W. B. H.

Travers' Golf Book. By Jerome D. Travers. Pp. xi + 242 + xlvi plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1913.) Price 8*s.* 6*d.* net.

THIS book will prove interesting reading to all golfers, and especially to those who aim at being champions. Mr. Travers tells how he attained his expertness—simply by thoughtful, deliberate practice. He gives many valuable hints on stance and grip, and elucidates these by means of photographs of himself in all sorts of positions, and with all kinds of clubs. He has the good sense to abstain from either superficial or profound discussion of the dynamics of the golf ball in air. He has no particular interest in the value of underspin, except in the extreme form for short approaches with mashie or niblick.

The Development of the Human Body. A Manual of Human Embryology. By Prof. J. Playfair McMurrich. Fourth edition. Pp. x+495. (London: Henry Kimpton, 1913.) Price 12*s.* 6*d.* net.

In this edition, Prof. McMurrich, who is professor of anatomy in the University of Toronto, has incorporated the results of all important recent contributions to the subject of human embryology. To avoid increasing the size of the volume unduly, several chapters have been recast and the rest of the volume revised thoroughly.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Post-Embryonic Development of the Spiny Lobster.

JE reçois actuellement au Laboratoire de Plymouth l'hospitalité scientifique la plus large, comme premier titulaire de la fondation annuelle récemment créée par l'Association britannique de biologie maritime en l'honneur de votre éminent compatriote M. le Professeur E. Ray Lankester. Les recherches que je poursuis en cette qualité me paraissent de nature à intéresser les zoologistes, et comme elles viennent de conduire à un résultat notable, je me permets de vous les signaler en sollicitant pour celui-ci l'hospitalité de votre important journal.

Ces recherches sont relatives au développement post-embryonnaire de la Langouste commune, *spiny lobster* des Anglais, *Palinurus vulgaris* des zoologistes, espèce peu répandue sur les marchés de la Grande-Bretagne, mais fort estimée en France où, d'ailleurs, elle devient rare et atteint des prix élevés. La famille des Langoustes compte à peu près vingt espèces, toutes de grande taille et comestibles, et toutes localisées dans les mers chaudes à l'exception d'un petit nombre qui s'avancent quelque peu dans la zone tempérée. La Langouste commune se range parmi ces dernières; c'est la seule Langouste des mers d'Europe; on la trouve en Méditerranée et, dans l'Atlantique, jusqu'à l'entrée de la Manche où elle atteint Plymouth grâce à la douce température des eaux du Gulf-Stream; on la pêche assez fréquemment autour du phare d'Eddystone.

Le développement post-embryonnaire des Langoustes est des plus remarquables, mais obscur en bien des points encore. On sait, depuis Couch (1857) et Gerbe (1863), que les Langoustes sortent de l'œuf sous la forme de larves pélagiques aplaties et transparentes que Leach (1816) avait prises pour un genre spécial et désignées sous le nom de Phyllosoma; on admet également, depuis les recherches de M. Boas (1881), mises en lumière par M. Calman (1909), qu'elles acquièrent ensuite une apparence macrourienne et deviennent nageuses sous une forme que M. Ortmann considérait comme autonome et désigna sous le nom de Puerulus; mais on n'a jamais suivi, depuis l'œuf jusqu'à l'adulte, le développement d'une espèce de Langoustes, l'on ne sait rien sur le genre de vie des puerulus qui sont d'une rareté extrême (vingt exemplaires environ dans tous les musées du monde), et ce dernier stade, pour notre Langouste commune, est resté jusqu'ici complètement inconnu.

C'est pour jeter quelque lumière sur ces points obscurs que je suis venu au Laboratoire de Plymouth; il se trouve à proximité du phare d'Eddystone, autour duquel notre Langouste commune n'est pas rare et se tient forcément localisée, ce qui le rend, plus que tout autre, favorable aux recherches de cette sorte. Je savais d'ailleurs que M. Cunningham avait recueilli près d'Eddystone, dans la première quinzaine de Juillet, des phyllosomes aux premiers stades, si bien qu'on pouvait s'attendre à capturer au même endroit, un peu plus tard, des phyllosomes plus âgés et peut-être, avec beaucoup de chance, le stade puerulus jusqu'alors inconnu. La réalité, comme on va le voir, a dépassé mon espérance.

Depuis le 20 Juillet jusqu'à ce jour, l'*Oithona*, bateau du Laboratoire, a capturé autour du phare d'Eddystone *tous les stades phyllosomes de la Langouste commune*; il y en a huit pour le moins. Au stade le plus jeune, décrit et figuré par M. Cunningham, la petite larve foliacée mesure environ 3 mm. de longueur; au stade le plus âgé, sa longueur atteint 20 à 21 mm. A l'heure actuelle, la plupart des phyllosomes sont âgés et, sans aucun doute, bien près de leur transformation. Le moment est donc des plus favorables pour obtenir le stade natant ou puerulus.

Puerulus de la Langouste commune; grandeur naturelle (photographie prise par M. F. Martin Duncan, du Laboratoire de Plymouth).

En fait, au cours d'une heureuse pêche effectuée le 31 Juillet sous la direction de M. Clark, on a recueilli des phyllosomes assez nombreux et un magnifique puerulus, *le premier puerulus connu de la Langouste commune.* Il fut pris avec le filet Petersen, entre deux eaux ("mid-water"), dans l'intervalle Looe-Eddystone, au-dessus d'un fond de 27–29 brasses.

Le petit animal est de même longueur que les grands phyllosomes (voir la figure, qui est de grandeur naturelle), comme eux incolore et translucide, mais avec la forme macrourienne normale. Ses grandes antennes ressemblent déjà beaucoup à celles de la Langouste commune, mais les antennes internes sont bien plus courtes et l'arceau qui les porte est bien plus large. Le rostre est réduit à une petite pointe médiane comme dans notre Langouste, mais les cornes rostrales ne présentent pas encore d'armature épineuse sur leur bord inférieur. Le bouclier céphalothoracique a dû se dilater anormalement sous l'action du formol, car ses parois latérales sont toujours abruptes et à angle droit avec la face dorsale dans les autres puerulus; d'ailleurs, il porte déjà quelques-unes des épines propres à l'adulte: deux paires de fortes épines post-rostrales, trois ou quatre paires de spinules gastriques, deux ou trois paires de spinules cardiaques et, sur chaque région branchiale, une série longitudinale de quatre ou cinq autres spinules; on trouve sur les régions hépatiques, dans le prolongement des grandes antennes, trois fortes épines plus développées encore chez l'adulte, et, à quelque distance en arrière, trois épines branchiales antérieures qui semblent faire défaut à ce dernier. Les grandes pointes marginales des épimères abdominaux ressemblent beaucoup à celles de l'adulte, mais les petites n'existent pas encore, les épines de la nageoire caudale sont moins nombreuses; toutes les autres, si abondantes chez l'adulte, font complètement défaut. D'ailleurs, les téguments sont coriaces et sans calcification aucune, l'abdomen est dépourvu des sillons transverses qu'on observe chez l'adulte, les pléopodes natatoires s'accouplent au moyen de crochets rétinaculaires, et les sternites thoraciques se prolongent en une pointe à la base des pattes, surtout à la base des pattes postérieures.

Ainsi, le petit animal ressemble déjà quelque peu à une Langouste, mais il s'en distingue par de nombreux caractères. On peut être assuré d'ailleurs qu'il passe directement à la forme définitive, car les très jeunes Langoustes sont à peu près de même taille.

On sait que la Langouste commune se range parmi les Palinuridés brévicornes (antennes internes à fouets courts); il en est de même de notre puerulus qui, par là même, ressemble aux puerulus de la Langouste du Cap (*Jasus lalandei*), de la Langouste néo-zélandaise (*Jasus verreauxi*) et d'une espèce caraïbe, le *Palinurus longimanus*. Il se rapproche surtout du puerulus de cette dernière espèce, car il présente comme lui des pointes sternales et, comme lui également, un exopodite flagellé sur les maxillipèdes externes. Les pointes sternales et le fouet des maxillipèdes font totalement défaut dans les autres puerulus brévicornes.

Nous voici donc, pour la première fois, *complètement renseignés sur le développement post-embryonnaire d'une espèce de Langouste*, et précisément sur celui qui nous intéresse le plus, le développement de notre Langouste commune: j'en possède tous les stades, depuis l'œuf jusqu'à l'adulte, et notamment le puerulus resté jusqu'ici inconnu. Que devient ce puerulus? Il est, on le sait maintenant, d'abord pélagique à la manière des phyllosomes, mais il doit gagner très vite le fond où il se cache et où une mue lui fait acquérir la forme des Langoustes.

Les résultats précédents semblent avoir quelque importance, car ils donnent la solution définitive d'un problème qui occupait les zoologistes depuis près d'un siècle. Je dois en rendre grâces au personnel si aimablement dévoué du Laboratoire de Plymouth, surtout au Directeur, M. Allen, qui fit multiplier pour moi les pêches pélagiques, et à M. Clark, Assistant, qui s'est employé à rendre les occupations fructueuses et, aidé de M. Gossen, a recueilli le premier exemplaire de puerulus. J'adresse à tous mes vifs remercîments, et à vous aussi, Monsieur le Directeur, si, comme je me plais à le croire, vous voulez bien donner l'hospitalité de votre journal anglais à un travail effectué par un Français dans les eaux anglaises.

E. L. BOUVIER.

Professeur au Muséum d'Histoire naturelle de Paris.

The Laboratory, Citadel Hill, Plymouth,
8 Août.

The Origin of Actinium.

THE question of the origin of actinium is one of very great interest at the present time. The law governing the position of the radio-elements in the periodic table led A. S. Russell, K. Fajans, and myself independently to predict the existence of a new member of the uranium series, the direct product of uranium-X, occupying the vacant place in the periodic table in the VA family, the heaviest known representative of which is tantalum. I suggested that if this "eka-tantalum" disintegrated dually, as in the case of the C-members occupying the place in the VB family, one mode with the expulsion of a β and the other with the expulsion of an α ray, the product of the first mode would be uranium-II., and of the second actinium. This could only have remained undetected if eka-tantalum had a very long period. The suggestion was disproved almost at once by the discovery of the missing element by Fajans and Beer, which has since been confirmed by Hahn and Meitner, and also by Fleck in this laboratory. It turns out to be a very short-lived member with a period of average life of about 1·7 minutes, and gives β rays only, the hard β rays before ascribed to uranium-X, which itself gives only soft β rays.

The obvious alternative was that actinium must be produced from radium in a β-ray change, that is that the first change of radium must be dual, the well-known α-ray change into emanation taking place simultaneously with a β-ray change into actinium. This suggestion receives some support from the fact that radium, as found by Hahn and Meitner, does give, in addition to α rays, a very soft β radiation.

But some experiments, of which I now wish to give a preliminary account, seem also to disprove this alternative. A specimen of Giesel's original radium bromide, now ten years old, containing 13·2 mgs. of radium (element) on the international standard, has been examined for actinium, and not the least trace could be detected. During the whole time since it was purchased, it had not previously been removed from its original ebonite capsule or subjected to any treatment. It was found to consist for the most part of insoluble sulphate, due to its action, no doubt, upon the sulphur in the ebonite capsule. It was brought into complete solution as chloride, radium-D, -E, and -F removed with a trace of bismuth by hydrogen sulphide, and a trace of aluminium chloride added and removed with ammonia. The aluminium hydroxide was repeatedly dissolved in acid and reprecipitated with ammonia until free from radium. The actinium and radio-actinium would remain with the aluminium, the actinium-X being completely removed with the radium from which it is non-separable. Tests for the active deposit were carried out in a stream of air, designed to replace the air in the box containing the preparation once every 5·6 seconds, the period of the actinium emanation. This was in order to suppress the effect of any radium relatively to that of the actinium, but it was not necessary, as neither radium nor actinium were present. On the other hand, a minute amount of the pure thorium active deposit was detected.

The α-ray effect obtained in the air stream mentioned with three hours' exposure, four days after preparation, when one-half of the equilibrium amount of thorium-X would be present, equalled that of about 0·15 mg. of uranium oxide, and was amply sufficient to characterise beyond all doubt. At first sight this result is surprising, but it is exactly what is to be expected if the chemical operations had been successful in their purpose. For there is thorium in Joachimsthal pitchblende, withal a very minute amount, and the corresponding mesothorium would be quantitatively removed with the radium, in the course of time to grow radiothorium. The detection of this infinitesimal trace of radiothorium by the active deposit test is a guarantee that if actinium had been formed it would have been detected, for radio-actinium and radiothorium are non-separable. An actinium active deposit, equivalent to less than 0·1 mg. of uranium in activity, could have been detected, and, taking into account the various corrections, it is reasonable to conclude that the full equilibrium amount cannot certainly be greater than that equivalent in α activity to 2 mg. of uranium. At present the preparation has reached about one-fourth of its equilibrium value as regards actinium-X.

In ten years, of the 13·2 mg. of radium in the preparation, 0·053 mg. would have disintegrated. On the assumption that uranium is the primary parent of actinium, Rutherford has calculated that 8 per cent. of the atoms disintegrating must choose the actinium route ("Radioactive Substances," p. 523). So that, if it were formed from radium, the amount of actinium present in the preparation would be 0·0042 mg. But the active deposit from this quantity has an α activity not greater than 2 mg. of uranium. Hence the period of average life of actinium must be at least fifteen million years, the quantity in minerals must be at least 170 grams per ton of uranium, and the α activity of pure actinium in equilibrium could not be greater than 1650 times that of uranium. But a specimen of actinium, prepared and presented to me by Dr. Giesel, must have, judging from a cursory examination, a far greater activity than this, and Mme. Curie ("Radioactivité," I., p. 189) speaks of some actinium preparations as of the order of 100,000 times as active as uranium. All the researches go to show that its actual quantity in minerals is very small, and, if there were anything like 500 times as much actinium as radium in minerals, one would have expected it long ago to have been isolated and its spectrum and chemical reactions characterised. So that the experiments appear to disprove the possibility that actinium can be formed directly from radium. Similar arguments to those above may be used to show that it cannot be a primary radio-element, and its origin remains still a mystery. In the current number of the *Physikalische Zeitschrift* (p. 752) Hahn and Meitner modify my original suggestion and suppose that the branching of the uranium series takes place at uranium-X, two simultaneous β-ray changes occurring, which produce two eka-tantalums, one the known short-lived β-ray-giving product, and the other a still unknown long-lived α-ray-giving parent of actinium, also in group VA. There seems nothing improbable about this. It is almost the only other alternative remaining to be tested, and it should not be difficult to settle by experiment.

Frederick Soddy.

Physical Chemistry Laboratory,
University of Glasgow, August 16.

Radium and the Evolution of the Earth's Crust.

Having been away from home, I did not see Mr. Holmes's letter on radium and the evolution of the earth's crust, contained in Nature of June 19, until some weeks after its publication, and thought that the interest in the subject would have so far passed as to make it not worth while referring to, what I believe to be, a considerable misapprehension of the structure of the earth as revealed by earthquakes. Later correspondence has shown that interest in the subject has not waned, and as a correct appreciation of what has been established regarding the constitution of the interior of the earth seems likely to remove some of the difficulties which have arisen out of the study of radio-activity, it may be useful to review the results obtained from the study of the transmission of earthquake waves to long distances.

To begin with, it must be distinctly understood that this line of research can tell us nothing, directly, regarding the chemical composition of the earth, nor can we distinguish between stony and metallic material; all that can be established is the rate at which two distinct forms of wave motion are transmitted, and if, at any particular depth, we find a marked change in these rates of transmission, we may say that it is caused by a change, either in chemical composition or physical state, of the material through which the waves have travelled. With this premised; the first great change takes place at, probably, about ten miles or so from the surface, and seems to correspond with the passage from the heterogeneous and fractured rocks of the outermost skin to more homogeneous material. Below this, and to a depth of about 100 miles, it is difficult to say whether any further change takes place; there are indications of change at about fifty and about one hundred miles, but it is not such as has a great effect on the rate of transmission of the simpler forms of elastic waves, and, as the differences in the time intervals concerned are not of a greater order of magnitude than the inevitable uncertainties of observation, it is difficult to be certain of the reality of the supposed alteration.

Below a depth of about 100 miles there is no evidence of any change until a depth of about 2400 miles is reached; throughout this layer there is a progressive increase of elasticity, but it is gradual and seems to be directly connected with the increase of pressure, with the result that the material, whatever it may be, develops a high degree not only of resistance to compression but also of rigidity as against stresses of short duration. At the depth mentioned, or at somewhere between 0·6 and 0·5 of the radius, measured from the surface, a very marked and remarkable change in the nature of the material, of which the earth is composed, takes place. The change is rapid, and is characterised by a small decrease in resistance to compression, accompanied by a great reduction, if not the complete disappearance, of rigidity. It is impossible to determine how this change is brought about, but it is very much what would be produced either by passage from the stony shell to the metallic core, of one hypothesis, or from the fluid or solid-fluid to the gaseous state, of another.

Whatever may be the final interpretation of the distant records of great earthquakes, the important point to be noticed is that the two great changes which they indicate in the constitution of the interior of the earth are, first, at a depth of only a few, probably not more than ten, miles, and, secondly, at about 2000 to 2400 miles from the surface. Between these depths there are suggestions of variations in composition down to a depth of 100 miles or thereabouts, but they seem to be of only minor importance, and apart from this no change in physical character, or, presumably, in chemical composition, can be detected.

R. D. Oldham.

8 North Street, Horsham, Sussex, August 15.

Poroscopy: the Scrutiny of Sweat-pores for Identification.

At the recent meeting of the British Medical Association some attention was directed to a method of criminal identification which has been used at Lyons and elsewhere. A fully illustrated account of it occurs in *Les Archives d'Anthropologie criminelle* for July, from which, after careful perusal, I cannot find that there is anything in the method that does not come under the scope and practical working of dactylography. Dr. Locard has shown good reason why we should give more attention than has been usual to small patches of finger-prints, and to seek among the pores for what the ridges are too meagre to supply. Dr. James Scott, at Brighton, rightly describes "poroscopy" as founded on a study of the "impressions or orifices of the sweat ducts of the finger pulp, instead of the ridges." But pores, the openings of sweat ducts, as printed impressions, cannot be studied quite apart from the ridges, or ridge substance, any more than the holes of which Pat's classic stockings consisted can be considered without reference to the slender remains of the fabric in which they occur.

Dr. Edmond Locard, the writer of the article, "La Poroscopie," alluding to certain landmarks in finger-print patterns (*puntos caracteristicos* they have been called), adduces in one of his illustrations some *îlots* of a single dot, each containing the opening of a single sweat-pore. The effect when printed is that of a more or less regularly shaped O or ring. Of course, if the smoked-glass method were used, what I have called the negative effect would be produced, and the pore would show up as a black dot on a white ground. In such a case as that illustrated the value of such a coincidence would be seen at once, but the value belongs much more to the system of ridges than to that of the pores. A dozen such pores might easily be found to coincide in two patterns having no real relation to each other by way of personality. I should not expect, however, after considerable experience of finger-print patterns, to find three volcanic or coral islets such as are depicted in Fig. 3 coinciding in any but two prints from the same person. But these volcanic islands are not mere pore openings. It is the sharp definition of the ridge element in them that gives character for identification.

It is difficult to conceive of many cases in actual practice where simple coincidence of pores could be made convincing to a jury. Such cases are presented with a magnification of forty-five diameters. But Dr. Locard says:—"Un jury, que trente ou quarante points caractéristiques homologues auront laissé indifférent, sera frappé par la concordance de forme, de position, et de nombre de quelques centaines de pores trouvés identiques sur les deux empreintes comparées." If the illustrations are from the exhibits in the criminal cases quoted, as one would be led to infer, the jury would seem to have been aided very greatly with outlines filled in by official pens, by which the rough places have been made smooth, and coincidences which would not strike any but police officials seeking a conviction, have been made vivid, if not always quite convincing. All this is, I trust, now quite foreign to English criminal procedure.

It is in cases where fewer than some twelve of what an English detective would in the witness-box call "characteristics" are to be found that the additional scrutiny of the pores might be useful. I agree with Dr. Locard that they remain locally fixed in position, but I have mentioned in "Dactylography" (Twentieth Century Science Series), which Dr. Locard does not seem to have read, that, their physiological activity being very variable, their shapes are constantly altering. They may be nearly closed one moment, and quite patent the next, a useful fact which makes it hopeless to forge finger-print signatures effectively with rubber stamps. This variability is most vividly shown in the illustrations to the very article now referred to, and where a finger-print pattern is doubled the pores always agree in position but rarely in shape or size. Henry Faulds.

36 Lichfield Street, Hanley, Stoke-on-Trent.
August 13.

Calanus—a Further Record.

On getting back to Tobermory on Saturday, we found the plankton to be in marked contrast to its condition four weeks ago (see Nature, p. 504). The vast swarm of Calanids has gone, and there are now no signs of mackerel feeding in the bay. In fact, the change has been noticeable for some days in the seas outside, and we have not been getting lately the large plankton catches that were usual in the latter half of July. On July 14 a haul of the large surface tow-net, in the open sea off Ardnamurchan, gave such a huge catch of Calanus (about 1000 c.c.) that we promptly took a second similar haul, and had it cooked as a sort of potted "shrimp" confection for tea (sampled by ten persons, including the crew, who were much interested to try this new edible "fish"); while on August 11 a haul of the same net, taken at the same spot, gave only a small catch of some 15 c.c., containing very few Calanids, along with the usual scanty summer zoo-plankton. I have not yet seen any statistics of the mackerel fishery, but should not be surprised if this proves to be an exceptionally good year in this neighbourhood, especially in July.

I have only just received Nature for the last few weeks, and am glad to read Mr. G. E. Bullen's further remarks (p. 531) upon swarms of Calanids and the fisheries. His excellent work—along with that of Dr. Allen—on the connection between mackerel and Calanus and sunshine in the English Channel, some years ago, is valued as the type of observational and statistical work that is required for the investigation of many fishery problems. W. A. Herdman.

S.Y. *Runa*, off Island of Eigg, August 12.

The Structure of X-Radiation.

In a letter which appeared in Nature of June 19 we described some effects obtained with various metals used as obstacles to X-radiation, which showed that the bands and haloes produced on X-ray plates up to distances of 450 cm. were neither dependent on crystalline structure (other than metallic) nor should probably be termed "diffraction" effects in the strict sense.

Further investigation, in which crystals have been entirely discarded, has led us to believe that some part of these effects at least must be referred to the structure of the primary beam.

In one of our early trials arranged to study the disposition of the spots from a thin lamina of mica, normal to the beam and covering a quarter of an inch aperture, we were surprised to find that spots were not present, but instead the photo plate, exposed at a distance of 50 cm., was entirely covered by dark parallel bands about half a centimetre in breadth and normal to a sharply defined bright cross. In later experiments without mica, and using cast-iron and other screens, both with and without apertures, a system of crossed similar bands has appeared, and a great number of trials have confirmed the result that particular metals (brass, lead, cast- and wrought-iron, &c., of various thicknesses up to 1 cm.) cannot be held responsible for these phenomena, which have even appeared when no other obstacle than a thick sheet of plate-glass has been interposed. A platinised-nickel antikathode has generally been used and 0·5 to 1 milliampere was kept constant through the bulb.

At it appears from Mr. Keene's letter in Nature of August 14 he has used only thin sheets of metal *with apertures*, we can understand that he has obtained somewhat dissimilar effects from ours obtained without any aperture in the screen. Also with super-cooled glass plates there can scarcely be any question of crystalline structure. We have substituted special rapid plates of various makers and changed all the non-essential conditions many times. When photo plates are placed one behind the other at distances of 15 cm. (up to 100 cm.) from the source, these bands have invariably shown most clearly on the plates farthest from it. This certainly would seem to suggest masking, by secondary radiation, of an effect which properly belongs to the primary or "hardest" portion of the rays. W. F. D. Chambers.
I. G. Rankin.

90 Gordon Road, Ealing.

SCIENTIFIC MOUNTAINEERING IN INDIA.[1]

H.R.H. the Duke of the Abruzzi undertook this expedition chiefly in the hope of contributing to the solution of the vexed problem as to the greatest height which can be reached by mountaineers. But, as usual, he supplied himself with such a staff as would be able to make good use of every opportunity which his journey might afford for scientific research. The basin of the Baltoro glacier was chosen for the attempt, owing to the number of high peaks at its head. K^2 itself proved to be unclimbable, in spite of several strenuous attacks and much close reconnoitring, and on July 1 the Duke turned his attention to Bride Peak, 25,110 ft. Such were the unexpected difficulties encountered that it was not until July 10 that camp was pitched on Chogo Lisa Saddle, 20,784 ft. On July 12 a height of 23,458 ft. was attained, but bad weather forced them to retreat. On July 17 another start was made, and that evening they pitched their two diminutive Mummery tents at 22,483 ft., the highest strictly authenticated camp to date, though Rubenson and Monrad-Aas probably camped as high on Kabru.

FIG. 1.—Jhula bridge at Karmang. From "Karakoram and Western Himalaya."

Next morning at 5.30 the Duke, with the guides Petigax, Henri and Emil Brocherel, started on what they realised was the final assault. At first all went well. But as they climbed mists settled on the mountain, and the snow got so soft that they sank in 2 ft. or more at every step. Yet "their fatigue was not very great" until at 24,278 ft. they reached a steep outcrop of rock. "Directly they had to climb with hands as well as feet, great difficulty in breathing became apparent," and it cost two hours to reach the highest rocks at 24,600 ft. A steep corniced snow-ridge stretched vaguely up into the mist.

FIG. 2.—Southern view of K^2. From "Karakoram and Western Himalaya."

The recurring tragedies on the Lyskamm are

[1] "Karakoram and Western Himalaya, 1909: An Account of the Expedition of H.R.H. Prince Luigi Amedeo of Savoy." By Filippo de Filippi. With a preface by H.R.H. the Duke of the Abruzzi. Vol. i., pp. xvii+469+plates; vol. ii., plates and maps. (London: Constable and Co., Ltd., 1912.) Price 63s. net.

an eloquent warning to all climbers against persistence in face of such dangers. The Duke waited vainly for two hours in the hope that the mist would lift, but at 3.30 p.m. was forced to retreat. Fortune was against the attainment of the highest peak—and in high mountain and polar regions weather is fortune—but the "man-level" was raised by 700 ft.

It is almost impossible for the uninitiated to realise the courage and fortitude called for by such a feat. For seventeen days they were never below 18,000 ft., and of these nine were spent at or

FIG. 3.—Empty basin of glacial lake. From "Karakoram and Western Himalaya."

above 21,000 ft. None of the party suffered from mountain sickness, and it is obvious that the limit of man's endurance has not yet been reached. The barometer stood at 12·35 in.: a further drop of only about 1·6 in. would be registered on the top of Mount Everest. But the successful aspirants will be very exceptional individuals—and of a consummate resolution

Dr. de Filippi has produced much more than an interesting and readable account of a memorable mountaineering expedition. Almost every chapter gives him occasion for the discussion of some branch of physical science. He appears to be familiar with the whole of the literature of his region, and gives so many references to the writings of his predecessors and other authorities that his book has the further merit of being, in the best sense, a work of reference.

The author's suggestive discussion of the past history of the Indus valley is of particular interest, but cannot be dealt with in this brief notice. Naturally glacial phenomena occupy most of his attention, and he throws new light on several vexed questions. The puzzling fact that the greatest glaciers of this region lack terminal moraines is ascribed to the immobility of their lower reaches. In a very long glacier lying in a narrow trough any increment shows itself by a rapid advance of the snout. The glacier overshoots itself, and if the increment is only temporary and the excess of pressure abates, this overshot portion becomes, in effect, merely a mass of stagnant, dead ice. Rickmers has reached, quite independently, a similar conclusion in regard to some of the glaciers of Russian Turkestan. Probably the few large boulders which do reach the snout of these great glaciers quickly sink below the surface of the water-soaked plain of glacial débris which is such a typical feature at the snouts of most of these glaciers.

The fact that the most careful barometric readings consistently gave lower values than trigonometrical observations suggests a reference to variations in gravity. It is by research on the lines adopted by Burrard that we may eventually look for an answer, and this problem is one of the many which the author has placed on the programme of his expedition to Baltistan and Ladak for 1913–14.

The author agrees with Ujfalvy in ascribing to the Baltis an Aryan rather than a Mongol ancestry. It is pleasant to read of the excellent relations existing between the Italians and their Balti coolies, for whom the author has nothing but praise and admiration, and to whom he frankly acknowledges much of the success of the expedition was due. The geological results are specially dealt with in an appendix. The most striking discovery was that the main axis of the Gasherbrum range consisted of sedimentary rocks, notably conglomerates and marbles. These are continued into the Teram Kangri range north of the Siachen glacier, and quite probably still further to the eastward.

The narrative is enriched with numerous illustrations by Vittorio Sella, that prince of mountain photographers; it is impossible to praise them too highly. In a separate case, uniform with the narrative volume, are placed a very remarkable series of large panoramas. These with the maps combine with the letterpress to give an extraordinarily vivid description of the region dealt with, especially of the Baltoro glacier. A useful innovation is that the indices are placed in a loose fascicle along with the panoramas and maps, which obviates the difficulty of reference so distracting with a heavy volume.

A CRITICISM OF MODERN METHODS OF MEDICAL EDUCATION.[1]

THE report drawn up by Mr. Flexner for the Carnegie Foundation is a sequel to the report on medical education in the United States and Canada issued in 1910. Primarily intended for the guidance of medical education in the United States, the report deals so fully with conditions in Germany, Austria, France, England, and Scotland, and adopts so critical an attitude towards them, that it must compel the attention not only of those directly concerned, but of educational authorities everywhere.

The report opens with an historical sketch of the rise of modern medicine, and is followed by a chapter on the number and distribution of physicians in the countries under review. We learn that the medical profession is overcrowded both in countries like Austria and Germany, where the practitioner is educated entirely on a high university basis, and in countries like our own, where medical qualifications of varying standards, some undeniably low, are obtained partly in universities and partly in proprietary schools under the control of the medical and surgical corporations. A later chapter in the report shows how quackery flourishes in Great Britain and Germany, a phenomenon Mr. Flexner attributes solely to the laws which permit it. Incidentally he remarks upon the inconsistency of British law which throws all manner of restrictions upon properly qualified men of science in experimentation upon the lower animals, but allows medical and surgical practice upon human beings without evidence as to training, competency, or skill, provided only the practitioner does not assume an unearned title.

From a purely educational point of view the most interesting part of the report is that which deals with the nature and standard of the medical preliminary examinations, and with the position of the preliminary sciences, physics, chemistry, and biology. The conditions in Germany, France, and Great Britain are closely reviewed, and much valuable information is collected. The German system of secondary-school leaving certificates, and the somewhat similar French system, are favourably considered; the want of method, multiplicity, and low standard of some of the British medical preliminaries receive severe condemnation. The work of the General Medical Council in raising the standard of the preliminary is acknowledged, but the condition of secondary-school education in England, though improving, is still lamentably poor, proprietary interests in the medical schools, and even in the universities, constitute a formidable barrier to progress, and the General Medical Council is not vested with sufficient legal authority to enforce everything it deems desirable.

The existence in Great Britain of proprietary interests in the teaching of medicine meets with severe criticism throughout the report; again and again vested interests are held responsible for inefficient teaching, low standards, and other evil influences. While we can agree with the author in many of his strictures, it must be remembered that the proprietary conditions have often been the only ones possible in a country which prides itself upon the voluntary character of its institutions. It must be remembered, too, that this report is drawn up for an educational body in the United States, where the proprietary medical school is a source of much scandal. The president of the foundation, in an introduction to the report, states that if the lowest terms upon which a medical school can exist abroad were applied to America, three-fourths of the existing American schools would be closed at once.

Mr. Flexner advocates the omission of physics, chemistry, and biology from the overcrowded medical curriculum, and would have them taught in the secondary schools. Much of this part of the report is a plea for the development of efficient secondary schools in which higher mathematics, the sciences, and German must replace the time-honoured classics.

Laboratory development is found to be very uneven in Great Britain as compared with Germany. Anatomy is too much drilled into the students by repeated lectures and demonstrations; more practical work is necessary, but is largely restricted by insufficiency of material. British physiology receives a high tribute, but is hampered by the student's lack of preliminary training in physics and chemistry, and by the anti-vivisection laws. Pharmacology barely exists but for a few notable exceptions. Pathology suffers by the separation of its laboratories from the post-mortem departments of the hospitals, by lack of funds for research, and by sentimental objections to pathological experimentation which carry great weight in hospitals chiefly supported by voluntary contributions.

Clinical instruction, the medical curriculum, and the position and standard of the professional examinations are each considered separately in the case of Germany, Great Britain, and France. Clinical education in England is essentially practical, and at graduation the English product is more dexterous than the German, but the latter is held to have received the more stimulating scientific training, and one which will eventually carry him further. The English graduate lacks ideas, the German lacks practice.

Criticism is abundant and frankly bestowed. The clinical school in Great Britain is accused of being unproductive of research, and wanting in scientific ideals. The German clinician and the British physiologist seek advancement by scientific achievement. The English medical man is able and practical, makes a good physician and surgeon, but is empiric, and only occasionally a contributor to scientific knowledge.

The report is bound to excite adverse criticism, for it is often detailed and very frank. It is the

[1] "Medical Education in Europe." A Report to the Carnegie Foundation for the Advancement of Teaching. By Abraham Flexner. With an Introduction by Henry S. Pritchett. Pp. xx+357. (New York City: 576 Fifth Avenue, 1912.)

work of an educational expert who has certain ideals, and does not hesitate to show how far existing conditions differ from them. Strong opinions are given on the vexed question of the London hospital medical schools, and on the constitution of London University. How far the recommendations are practical is a question that must be left for the authorities concerned to decide. It is certainly desirable that London as a teaching centre of medicine should not occupy a position inferior to the great schools of Berlin, Vienna, and Paris.

Whatever we may think of some of the author's criticisms, one cannot but admire the ability and thoroughness with which he has collected information and drawn up his report. Educationists generally, and medical teaching authorities in particular, owe a debt of gratitude to the Carnegie Foundation for the Advancement of Teaching.

LIQUID CRYSTALS AND THE X-RAY WORK.

IN two memoirs contributed to the current volume of the *Verhandlungen des Naturwissenschaftlichen Vereins*, Karlsruhe, Prof. O. Lehmann gives a valuable summary of his well-known researches on the so-called liquid crystals, and reviews the proofs now available of molecular structure and of the operation of molecular forces, and especially the tangible proofs of the actual existence of molecules. Naturally, the most interesting part of such a communication from Prof. Lehmann is the expression of his views concerning the most recent of such proofs, afforded by the experimental work of Laue, Friedrich, and Knipping with X-rays and crystals at Munich and Zurich. The events leading up to this remarkable development are clearly indicated, and their individual significance emphasised. From the initial stages of the kinetic theory of gases in the days of Count Rumford and Robert Mayer—the former of whom was connected with Munich, and is there represented by a fine statue—to the reflection of X-ray electromagnetic waves from the invisible parallel planes of atoms in the interior of a crystal, and the impression of the systematic symmetry of the crystal on a photographic plate by the reflected rays, is a long step.

It will be with universal consent that Prof. Lehmann hails this new work as of richest consequence not only to crystallography, but to general physics. He considers it the first practical proof of the existence of those molecular forces which he has so long contended for as causing the deposition, layer upon layer in regular order, of the chemical molecules in their erection of the edifice of a crystal—that is, in the production of a three-dimensional grating or "space-lattice."

One of the surest signs of the magnitude of the discovery made at Munich is the fact that the experiments, as on the occasion of the discovery of radium, are being repeated and extended by numerous workers all over the world, as the columns of NATURE, in which many of the results have been described, have lately abundantly testified.

It is a generally accepted maxim amongst men of science that the pioneer of a new discovery should be permitted to work out undisturbedly its further development, and it is sincerely to be hoped that Prof. Laue and Drs. Friedrich and Knipping will be able to carry their work to its logical conclusion. The bearing of the discovery on Prof. Bragg's theory of X-rays has, however, fully justified its further independent investigation by him and by his son, Mr. W. L. Bragg, who has crystallographic knowledge, and has added very considerably to the subject, both by further experiments and by an explanation which agrees with the crystallographic facts in a most remarkable manner. There are indications that the near future will see a surprising further development in the direction of arriving at the absolute dimensions of the cells of the space-lattice—that is, of the actual distances separating the chemical atoms, thus converting the topic axial ratios, which have been so useful a conception for affording us the relative dimensions of the cells in related compounds, into absolute spacial values. Moreover, the dimensions of the material parts of the atoms themselves appear likely to be also determinable within definite narrow limits, for the reflector, the atom, must be larger than the wave reflected, and it is now clearly proved that an ordinary reflection, and not a diffraction effect, is in question.

Another secondary result is that the intensity of the reflection is proving a direct function of the density with which the atoms are strewn in the reflecting plane, thus affording us an experimental means of carrying out Prof. von Fedorow's quest for the primary facial planes, so as to arrive at a proper descriptive setting for the crystal; for these primary planes, sometimes obscured by fortuitous better development of other planes on the exterior of the crystal, are invariably those most densely strewn with the atomic points.

For a discussion of the physics of the whole subject, especially as regards the position immediately before the Munich discovery, the two memoirs of Prof. Lehmann forming the subject of this notice may with advantage be consulted. A brief abstract of some of the most recent work of Mr. W. L. Bragg will be found in the report of the proceedings of the Mineralogical Society of June 17 (see NATURE of June 26, p. 441).

A. E. H. TUTTON.

THE PILTDOWN SKULL.

AMONG the questions discussed by the anatomical section of the International Congress of Medicine was the date and reconstruction of the famous Piltdown skull. At South Kensington the fossil portions of the skull have been put together by Dr. Smith Woodward so as to represent a being partly ape, partly human, and named *Eoanthropus dawsonii*. From this model the brain gives a capacity of 1076 c.c.—an amount intermediate between the highest anthropoid and the highest form of man.

Dr. Smith Woodward fixes its date in the very early Pleistocene period, contemporary with the well-known Heidelberg jaw. Prof. Rutot, of Brussels, assigns the Piltdown stratum of gravel in which the remains were found to the latter part of the Pliocene period. If these views be accepted, it is of much earlier date than the remains of Neanderthal man recently discovered in France; and while Prof. Rutot estimates the duration of the Pleistocene period at 150,000 years, Prof. Penck, one of our greatest authorities on the Glacial period, estimates its duration from half a million to a million and a half of years.

On the other hand, Prof. Keith, of the Royal College of Surgeons, has articulated the portion of the skull to represent a large and well-modelled human head with a brain capacity of 1500 c.c—an amount slightly above the average of modern human brains.

The difficulty of accepting Dr. Smith Woodward's reconstruction is in believing that Eoanthropus could be transformed into modern man in the short period represented by the first half of the Pleistocene period. On the other hand, to quote the admirable summary of the question in *The Times* of August 11, "if Prof. Keith is right, then it is quite possible that mankind may have reached the stage represented by the Galley Hill remains before the middle of the Pleistocene period. If Dr. Smith Woodward is right, we have to seek the beginnings of our modern culture and civilisation at the middle of the Pleistocene period; if his opponent's reconstruction is well founded, we have to go a whole geological period further back—perhaps a million of years—to find the dawn of modern man and his culture."

In the discussion which took place, reported in *The Times* of August 12, the weight of scientific opinion seems to have been decidedly in favour of the views of Prof. Keith. But the importance of the question is so vital to the science of anthropology that we may be well advised to await further developments of the controversy.

HELMINTHS AND CANCER.

In a memoir recently published,[1] Dr. Johannes Fibiger brings forward strong evidence in support of the view, by no means novel, that the lesions of the tissues produced by parasitic worms may act as the starting-point for the development of cancerous growths and tumours. The author found in wild rats a disease of the œsophagus and stomach characterised by an epithelial proliferation and inflammation leading, in pronounced cases, to a papillomatous growth which was the precursor of a malignant epithelioma. Examination of the primary lesions revealed the presence of a nematode worm, an undescribed species of Spiroptera.

From a series of experiments it was concluded that cockroaches (*Periplaneta americana* and *P. orientalis*) serve as intermediate hosts for the Spiroptera. The cockroach becomes infected by ingesting eggs of the worm which are passed out in the excrement of the rat; the eggs develop in the cockroach and the embryos of the worm become localised in the striated muscles of the prothorax and the legs. The rats become infected by eating cockroaches, and the embryos of the worm, set free from their cysts, attack the epithelium of the stomach, sometimes also that of the œsophagus or buccal cavity, and develop into the adult nematode, the cause of the lesions already mentioned. From his investigations the author concludes that all the anatomical alterations are due to toxic products of the nematode.

From the primary lesions caused by the nematode secondary metastases may be produced in other organs. The metastases contain neither the parasites nor their eggs. The development of the metastases is ascribed to the faculty of the epithelial cells to multiply in other organs independently of the parasite. The author thus confirms the view put forward by Borrel and others that nematodes may produce malignant tumours in rats and mice, and considers it not improbable that in human pathology also cancerous tumours may owe their origin in some cases to the presence of helminths.

[1] Oversigt Kgl. Danske Videnskabernes Selskabs Forhandlinger, 1913, No. 1.

NOTES.

A circular from the Institut International de Physique Solvay informs us that a sum of 20,000 francs is available for the encouragement of experimental work in physics and physical chemistry, particularly for investigations on radiation phenomena (Röntgen rays and those of radio-active bodies) and for studies of the theory of energy quanta and of molecular theories. Grants from the fund will be awarded, without distinction of nationality, by the administrative commission of the institute on the recommendation of the international scientific committee. The administrative commission is composed of Profs. P. Heger, E. Tassel, and J. E. Verschaffelt, Brussels, and the scientific committee of M. H. A. Lorentz, president, Haarlem; Mme. M. Curie, Paris; M. Brillouin, Paris; R. B. Goldschmidt, Brussels; H. Kamerlingh-Onnes, Leyden; W. Nernst, Berlin; E. Rutherford, Manchester; E. Warburg, Berlin; and M. Knudsen, secretary, Copenhagen. Applications for grants should be made before September 15 to Prof. H. A. Lorentz, Zijlweg 76, Haarlem, Holland. They should state precisely what problems are to be investigated, the proposed means of inquiry, and the amount required, in order that the committee may have before it all details necessary in considering the awards to be made.

An exhibit illustrating the damage caused to biscuits sent out in soldered tins for the use of the troops in South Africa—especially during the Boer war—Gibraltar, Malta, Ceylon, &c., has just been placed in the central hall of the British Museum (Natural History), where it will be kept open about a month. The larvæ of certain minute moths and beetles were the active agents; and it appears that since these cannot, in all probability, withstand the high temperature to which the biscuits are subjected in baking, the eggs must be laid by the moths during the period when the biscuits are being cooled before tinning. Two species of moths, *Ephestia kuehniella* and *Corcyra cephalonica*, both imported into this country, are the chief causes of the damage; and as a consequence of the ravages of the larvæ, the contents of many of the tins are reduced to uneatable rubbish.

The death is announced, as the result of an accident, of Prof. C. Bourlet, professor of mechanics at the Conservatoire des Arts et Métiers in Paris.

The Permanent International Eugenics Committee has accepted the invitation of Dr. C. B. Davenport, of Cold Spring Harbour, Long Island, to hold the International Eugenics Congress in the United States next year, probably in the month of September.

Mr. C. Carus-Wilson has recently presented to the Royal Albert Memorial, Exeter, the large specimen of a granite geode exhibited by him at more than one Royal Society soirée, and awarded the bronze medal of the Franco-British Exhibition. The specimen is a fine mass of granite in which the mineral constituents have crystallised out around the walls of a large cavity.

It speaks well for a general appreciation of the scientific value attaching to Arctic and Antarctic research that the actual conquest of both poles has not been followed by any diminution of exploring activity. News is to hand of the success of Captain Koch's Danish expedition for the crossing of Greenland. Captain Koch, who accompanied Mylius Erichsen on the journey which ended with that brilliant explorer's death, started in June, 1912, with the object of visiting Queen Louise Land. The party failed to carry this out owing to an accident which kept Captain Koch a prisoner for three months, after which winter was passed on the inland ice of Greenland. The expedition, starting on April 20 of this year from near the east coast, reached Proeven, near Upernivik, in the middle of July, after a march of 750 miles towards the close of which the party was within a few hours of starvation. A more prolonged journey is planned by Captain Amundsen, the first explorer to reach the south pole, who is shortly to board the *Fram* at Colon, when that famous vessel will sustain the honour of the first passage through the Panama Canal. She will then convey Amundsen to the Arctic, where he hopes to carry out a drift (such as Nansen attempted) across the polar area, being prepared to spend six years over the task, a period which should afford him almost unprecedented opportunity for scientific investigations.

In the issue of *Man* for August Mr. T. A. Joyce describes the representation of the clan ancestor in animal form on ancient pottery from the Peruvian coast. The result of the investigation is to emphasise the importance of the clan ancestor in Peruvian cults, to illustrate the custom of dancing in dresses simulating animals, these dresses being almost the only kind of personal property under the communistic system of the Incas, and to show the wide distribution of the centipede as a *huaca* or totem in the Nasca Valley.

Perhaps the most important paper in the excellent issue of the Journal of the Royal Anthropological Institute for January–June is the report by Mr. A. R. Brown, Wilkin student in ethnology, Cambridge, on three tribes in Western Australia—the Kariera, Ngaluma, and Mardudhunera. The paper describes in detail the complicated tribal organisation, totemism, rites of initiation, sociology, and religious beliefs of a people now rapidly disappearing. A good series of outline maps and a bibliography of the scanty published literature add to the value of this paper.

In the issue of *L'Anthropologie* for January-February, 1913, Prof. H. Breuil and H. Obermaier publish a review of the work done in examining the cave paintings in Spain during 1912. A number of curious illustrations of men and animals is provided. The visit of M. Breuil and Prof. Sollas to Bacon Hole, near Swansea, is described. It is possible that the red bands observed on the cave walls may be the work of Palæolithic man, or they may belong to some later period; but there is no reason for trusting the local gossip which ascribes them to quite modern times.

In 1906 Mr. R. F. Cummings supplied the Field Museum at Chicago with funds for an ethnological expedition to the Philippine Islands. The first part of the results of the investigations by Mr. F. C. Cole has now been issued in vol. i., No. 1, of the Museum's Anthropological Series. It is devoted to a study, historical and ethnographical, of the introduction of Chinese pottery into the islands. This pottery was chiefly intended for use by some of the Filipinos as burial jars. These in time acquired a high value, and were believed to possess supernatural properties. Among some tribes the bride-price is paid wholly or partly in jars. Porcelain plates are used by female mediums in summoning spirits, and such plates are so highly valued that they are never sold during the lifetime of the medium, and after her death only to her successors in office. The medium falls into an ecstatical state, chants songs invoking the spirits, and holding the plate on the finger-tips of her left hand, she strikes it with a string of seashells or a piece of lead, in order that the bell-like sound may attract the attention of the spirits. Suddenly a spirit possesses her, and she announces its wishes to the audience. This elaborate and well-illustrated monograph will interest anthropologists and collectors of Oriental porcelain.

A profusely illustrated article by Mr. George Shiras on automatic flashlight photography of wild animals by night forms the leading feature of the July number of *The National Geographic Magazine*. In fixing self-acting cameras in the haunts of nocturnal mammals, the author states that he has frequently used the same baits and scents as those employed by the trapper, and he adds that in many instances animals, after a brief experience, take little or no notice of the flashlight, which they perhaps regard as a form of lightning.

Mr. M. C. Tanquary has published, as article 9 of vol. ix. of the Bulletin of the Illinois State Laboratory of Natural history, an account of recent biological and embryological studies on Formicidæ, based on investigations into the habits and life-history of the American cornfield ant (*Lasius niger americanus*). Although this is believed to be the most abundant insect in the United States, such an investigation had never previously been undertaken, so that a number of new facts in its ecology have been brought to light.

ALTHOUGH the majority of the birds represented by fossil bones in the Pleistocene of the Oregon desert belong to species still existing, it is not a little remarkable that they include two extinct species of swan, one of which—*Olor matthewi*—is described for the first time in a paper on the fauna of the tract by Dr. R. W. Shufeldt, in the Bulletin of the American Museum of Natural History, vol. xxxii., art. vi. Noteworthy, too, as indicative of climatic changes, is the occurrence of remains of the snow-goose. In connection with the determination of fossil bird-bones, Dr. Shufeldt points out that in many cases allowance must be made for great differences in length due to differences in age and sex of the birds to which they belonged, and other conditions. Neglect of this may lead to very erroneous determinations.

AT the conclusion of an article on the food of insects in *Naturwissenschaftliche Wochenschrift* of July 13 and 20, Dr. Hans Petersen points out that the chlorophyll found in the intestine of caterpillars becomes modified into a red substance—"vanessa red"—which is used in the epithelium, and, after pupation, as a pigment in the wings and other parts. Part of the red matter remaining unabsorbed in the intestine is finally voided. He also comments on the remarkable fact that the larvæ of clothes-moths subsist on absolutely dry keratin—the main constituent of wool—which all other animals seem completely unable to digest and assimilate. In regard to the consumption of wax by the larvæ of the wax-moth, it is considered that although this substance is essential to their existence, it is largely supplemented by remnants of pollen, honey, &c.

APPARENTLY more or less harmless in its reputed native country, the Argentine ant (*Iridomyrmex humilis*) is a serious enemy to vegetation and crops in the numerous lands—including the warmer parts of the United States, Madeira, and Portugal—into which it has been introduced. So injurious indeed is this insect in Louisiana and some of the neighbouring States that its ravages, according to a special report by Messrs. W. Newell and T. C. Barber, published as Bulletin No. 122 of the U.S. Bureau of Entomology, are fully as bad as those of the caterpillars of the gipsy-moth, the boll-weevil, and the San José scale-insect. With the view of checking this mischievous ant, full details of its life-history have been worked out and recorded in the bulletin, together with suggestions as to remedial measures. In the orange orchards, where these ants have done incredible damage, the most successful plan has been to induce the colonies to congregate during winter in boxes filled with decaying vegetable matter, where they are subsequently destroyed by means of carbon bisulphide.

DR. P. VAN HARREVELD, who some years ago (*Rec. d. Trav. bot. Néerlandais*, vol. iii.) pointed out various imperfections in the forms of klinostat hitherto used in experiments on geotropism, heliotropism, and other phenomena of movement in plants, has now published in the same journal (vol. ix.) an account of a new form of this instrument devised by him. This "Universal Klinostat" is of somewhat complicated construction, which is illustrated by eighteen figures showing the various parts in detail, and the author claims that his form of this important instrument successfully eliminates all the sources of error arising from the use of the forms of klinostat that have been in use up to the present time; for details reference must be made to the author's paper.

WE have received a copy of Prof. Guignard's memorial notice on the life and scientific work of the late Dr. Edouard Bornet, who died on December 18, 1911, at the age of seventy-three years. The list of Bornet's publications extends to nearly sixty titles, but he will be best remembered for his work on the algæ, and particularly for the two well-known volumes "Etudes phycologiques" and "Notes algologiques," which he produced in collaboration with Thuret between 1876 and 1880. The magnificent plates which illustrate these two works have never been surpassed for beauty and fidelity to nature in the entire range of botanical literature. In Prof. Guignard's admirably written and sympathetic sketch of Bornet's labours, we are taken back to what now appear extremely remote times and shown what an important part Bornet played as a pioneer in establishing the sexuality of the cryptogams and the dual nature of the lichens.

IN a paper of considerable interest to geologists as well as to botanists, Dr. J. B. Scholz (*Engler's Bot. Jahrb.*, vol. xlvi.) discusses the "steppe problem" of the north German plain. There is at the present day a strong contrast between the mild equable climate of north-west Europe and the dry continental climate of the steppes of south Russia and west Siberia, but that the steppes had formerly a greater westward extension during at least one drier climatic phase in late Glacial times was shown by Nehring from the distribution of the loess with its characteristic steppe fauna, implying a corresponding steppe flora and climate. Scholz now brings forward various botanical evidences against the probability of a long steppe period in west Prussia, with interesting notes on the distribution of the characteristic steppe grass, *Stipa pennata*, and accompanying plants, pointing to the conclusion that these plants have entered north Germany along the valleys of the Vistula, Oder, and Elbe, all of which have the general direction south-east to north-west.

IN a paper published by the Survey Department of the Egyptian Ministry of Finance, Dr. John Ball discusses the occurrence of the phosphate deposits found in the localities bordering on the Red Sea coast and in the Nile districts. In the Satâga district alone these phosphate beds are believed to exist over about fourteen square kilometres, and have been found to contain 20 to 70 per cent. of tricalcic phosphate. During the five years 1908–12 the output of phosphate has risen from 700 to 70,000 tons, and, now that the mines are connected by rail with the seaboard, Egypt bids fair to contribute a not insignificant portion of the world's production.

THE first part of vol. viii. of the quarterly *Agricultural Journal of India* contains a number of interesting and important papers, including the following. Mr. H. Maxwell-Lefroy reports at length upon the Psylla disease of indigo, which apparently causes part only of the unhealthy conditions observed in the plants. The author considers that the insect is the direct cause only of curling of the shoot tips and leaves, with a checking of growth, leading to decreased weight of cut plant and a small decrease in the seed yield; while the more extensive and serious disease symptoms exhibited by indigo plants are attributed to some at present unknown organism or physiological cause quite independent of Psylla. The issue includes papers on the improvement of Indian wheat, by Albert and Gabrielle Howard, and that of the indigenous cottons of the United Provinces, by H. Martin Leake and A. E. Parr; while G. S. Henderson contributes an interesting paper on dry farming, based on his visit to dry-farm stations in Texas and New Mexico, and C. M. Hutchinson describes experiments on the relation between drainage and the growth of rice.

IN a paper by Prof. A. J. Ewart and Mr. Norman Thomson, published in the Proceedings of the Royal Society of Victoria (vol. xxv., p. 193), the question of the possibility of cross-inoculation of the root-tubercle bacteria upon native and cultivated leguminosæ is discussed. It was found impossible to cause the growth of root nodules on a number of commoner leguminosæ by inoculation with infusions of the tubercles of certain native legumes, such as *Acacia mollissima*, and different species of Papilionaceæ. This is apparently due to the fact that the bacteria of such nodules are incapable of directly adapting themselves to a new host plant. On the other hand, when the bacteria from one plant are grown on nutrient gelatin media, they appear to develop more generalised infective power, and it was found possible readily to infect peas and broad beans, grown both in water cultures and in sterilised soils, with bacteria from acacia nodules, isolated and cultivated on nutrient gelatin. Root-tubercle bacteria taken directly from the living tubercle are, however, apt to die out in sterilised soil or in water cultures before they have become sufficiently generalised to be capable of infecting a foreign host plant.

THE earthquake of November 8, 1912, in the south-east of Luzon presented several features of interest (Bulletin of the U.S. Weather Bureau). It was preceded by a number of slight shocks, beginning on November 5. Though strong enough to cause considerable damage, the meizoseismal area was small, being only twenty-two miles long and six miles wide. As the Rev. M. Saderra Masó points out, this implies that the focus was close to the surface. The earthquake was nevertheless registered at Hamburg and San Fernando, more than 6000 miles from the Philippine Islands. No lives were lost, owing to the lowness of the houses, the lightness of their materials, and the ample time that elapsed before destructive intensity was attained.

PROF. OMORI has recently described the extraordinary volcanic eruption of the Usu-san in July and August, 1910 (Bull. Imp. Earthq. Investigation Com., vol. v., 1911, pp. 1–38). The eruption was accompanied and followed by the formation of a new mountain on the northern flank of the volcano. By November the height of this mountain had increased by 510 ft., though by April, 1911, this amount was lessened by 120 ft. In a later paper in the same volume of the bulletin (pp. 101–7), Prof. Omori shows that the elevation-phenomena were not confined to the northern side. At his request the heights of the first order bench marks were re-determined to the west and north-west of the volcano in the summer of 1911, and along the same lines and also on the south side of the mountain in the summer of 1912. The first measurements indicated an elevation of the ground surrounding the mountain to a distance of three to five kilometres to the west, the maximum rise being about $2\frac{1}{2}$ metres. At a greater distance to the west there was a slight subsidence. The measurements made in 1912 showed a reversal of the movement, the area surrounding the mountain being slightly lowered, while that beyond to the west was slightly raised.

THE meteorological charts of the North Atlantic for August, issued by the Meteorological Office and the Deutsche Seewarte, contain interesting details relating to the ice in that ocean. On the east and north coast of Newfoundland, and on the northern half of Newfoundland Bank and eastwards, many icebergs are still met with. The latest reports received from the scout-ship *Scotia* relate to ice between 48° N. 50° W., and 47° N. 45° W., July 11 to 15. During June icebergs were met with, east of 45° W., as far south as the steamship routes. Small charts are published by the Meteorological Office giving the extreme limits of icebergs in the north-western Atlantic for each of the months March to June during twelve years ended 1912, and also during the year 1913. This year the bergs have been confined to higher latitudes, as a general rule, than in previous years. This is thought to be probably due to a northerly extension of the Gulf Stream, a northerly set having been reported by several steamers. The bergs seen have been comparatively few in number and of small dimensions.

THE *Mitteilungen aus den deutschen Schutzgebieten*, vol. xxvi., part 1, contain valuable tables of monthly and yearly means of meteorological observations for 1911, made under the auspices of the Imperial Colonial Office, and discussed at the Deutsche Seewarte under the able superintendence of Dr. P. Heidke. Among several useful articles we may mention an investigation of the nature of the obscurity of the air during the prevalence of the Harmattan wind at Togo, West Africa, with reports (1) by Captain v. Seefried, who conducted the experiments with glass filtering tubes packed with wadding, and (2) by the Geological Central Section for German Protectorates. The cloudiness has been supposed by some authorities to be due to ashes from grass fires, and by others to dust particles from desert regions. The geological report is to the effect that the principal cause is essentially due to the remains of diatoms, and that the presence of particles of ashes is only to be considered as a secondary and local phenomenon. It is pointed out that this result agrees with opinions as to the nature of the dust observed in the vicinity of Cape Verde Islands, and it is suggested that some botanist skilled in the examination of diatoms might determine from their forms the place of origin of the dust particles obtained in Togo.

The Survey Department of Egypt has recently published an important volume containing daily readings (August, 1872–December, 1911) of the Nile gauge at Roda (Cairo), together with summaries and diagrams. In a preface by Mr. J. I. Craig (director, Meteorological Service) it is pointed out that projects are in hand, or proposed, that will tax the supplies of the river to the utmost, and that it is more than ever desirable that existing records should be made accessible. With the exception of the nilometer at Aswan, the gauge at Roda is the oldest in the country; its readings have been recorded (with several gaps) for about thirteen centuries, but it is only from 1872 that complete daily readings exist, and up to the end of 1899 these were recorded according to the Coptic calendar and in old measures, so that the figures were of little value to European investigators. The formidable work of conversion to Gregorian dates and to modern measures, together with computations for the whole period in question, has been carried out with scrupulous care by Mohammad Effendi Kâsim (inspector, Meteorological Service), who has also contributed the introductory text. This period of daily records includes five cases of high floods (exceeding 20 metres) and five cases of low floods (not exceeding 18 metres), also years of abnormally early and late floods, such as that of 1880 (forty-nine days early) and that of 1894 (twenty-four days late).

In a paper presented to the Astronomical and Astrophysical Society of America in January, and reprinted in abstract in the July Journal of the Washington Academy of Sciences, Mr. W. J. Humphrys, of the United States Weather Bureau, examines the question whether the presence of volcanic dust in the upper atmosphere is sufficient to account for the periods of abnormal cold which have at times been experienced simultaneously over the whole earth. He finds that the meteorological records from 1750 onwards show that cold periods were in every case preceded by volcanic eruptions, and that the greater the eruption the longer the period of unusual cold. In the case of the eruption at Krakatoa in 1883 the years 1884–5–6 were all 1° or 2° F. below the normal temperature. Measurements made at the U.S. Weather Bureau since 1883 show that dust in the upper atmosphere produced by an eruption may decrease by 20 per cent. the intensity of solar radiation received at the earth's surface.

OUR ASTRONOMICAL COLUMN.

A Star with Large Proper Motion.—In *Astronomische Nachrichten*, No. 4674, Miss E. F. Bellamy directs attention to the large proper motion of Helsingfors 914, which was found when assisting the Vatican Observatory in the reductions of its portion of the Astrographic Catalogue (zones +65° to +55°). The star is close to Hels. 913, and since the seconds of R.A. in the Helsingfors Catalogue for 914 and 913 are 44·8s. and 44·2s., whereas in BD they differ by 5s., and the Vatican residuals also differed by nearly 5s., it was at first thought that there was a mistake in Helsingfors. Subsequent investigation showed that Hels. 914 had a considerable proper motion, the motions being +0·236s. and +0·36″ annually. Miss Bellamy points out that the centennial proper motion in arc of a great circle is +157·0″, the largest proper motion hitherto found in either the Oxford or Rome work, the next largest being 141·9″.

"Giant" and "Dwarf" Stars.—In an address given at the meeting of the Royal Astronomical Society in June last, and reported in the current number of *The Observatory*, Prof. H. N. Russell presented a short account of the studies which have led him to adopt a theory of stellar evolution through stages of increasing and decreasing temperatures, as Ritter deduced from thermodynamical considerations and similar to the idea of a "temperature curve" which spectroscopic work led Sir Norman Lockyer to suggest represented the course of development of a stellar body from a sparse meteoritic swarm to a dense, feebly radiating, and dying sun. Briefly, by considering absolute magnitude (a function of mass, density, and surface brightness) and spectral type, Russell finds that there are no faint white stars; all the very faint stars are red, and among the reddest stars, K and M classes, there is a distinct separation into two groups, one much brighter, the other much fainter, than the sun. To explain the existence of the two kinds of stars, the "giant" and "dwarf" stars first noticed by Dr. Hertzsprung, recourse is made to the evidence afforded by double stars and eclipsing variables; from the former differences due to mass are eliminated, and from the latter the effects of variation of density are deduced. It appears that the series of dwarf stars is one of slowly increasing density from B to M, while among the giant stars density decreases very rapidly from B to M, and it is suggested that the giant stars of class M represent a very early stage of evolution, class B a stage near the middle, and the dwarf stars later stages according to increasing faintness and ruddiness. As a confirmation of the theory it is pointed out that the actual densities of the stars of class A and B are of the order of magnitude (one-tenth that of water) at which Lord Kelvin predicted temperature should be a maximum.

The Stationary Radiation of Meteors.—The present position of this puzzling question in the field of meteoritic astronomy is discussed by Mr. W. F. Denning in the August number of *The Observatory*. The observational difficulties and possible accuracy of determinations of radiants are indicated. The reality of the phenomenon is insisted upon, and some of the unsatisfying explanations which have been offered by Greg, Ranyard, Proctor, Herschel, and Turner, among others, are briefly mentioned.

THE LANCASHIRE SEA FISHERIES LABORATORY.

THE twenty-first annual report of this laboratory contains an interesting record of the routine work and investigations carried on during 1912. The usual four classes for fishermen were held at Piel during the spring; fifty-two fishermen received instruction in marine biology, with special reference to the life-history and habits of fishes and the more common invertebrates captured in the trawl-net, and thirty-nine of the men attended also the course in navigation.

Mr. Johnstone continues his records of diseased conditions of fishes. He describes and figures a fibromatous tumour from a halibut, melanotic sarcomata in skate, and tubercular lesions in a cod. Piscine tubercle has been known hitherto only in freshwater fishes, and it is therefore of interest to find the present typical lesions in a fish living in the open and not likely to have become infected by land-drainage. Dr. Alexander contributes a review of piscine tubercle, and gives a description of an acid-fast bacillus found in the cod above-mentioned. The lesions were skin infections, resembling lupus, and containing typical tubercles. The organism was found to be non-pathogenic for the guinea-pig.

Mr. Johnstone gives a detailed report on the more important mussel-beds in Lancashire and North Wales in regard to their liability to sewage contamination. His investigations show that the mussels from certain areas, *e.g.* parts of the Conway and Lune estuaries, are objectionable as articles of food, and he urges the necessity for supervision of natural shellfish beds, in the interests not only of public health, but of the shellfish industry.

In his account of the measurements and variations in the condition of plaice, Mr. Johnstone suggests that the main cause of the periodic migrations made by plaice is change of temperature. The migration is of the nature of an adaptation to a change in the environment, the plaice responding by so moving that the temperature-change becomes minimal.

Mr. Riddell gives an account of the plankton collections obtained during 1912 in the Irish Sea. Prof. Bassett, in reporting on the water samples taken at the same time, points out that very high salinities prevailed throughout the year 1912, especially at certain stations on the line from Holyhead to the Calf of Man, due to the flooding of the English Channel and Irish Sea by water of Mediterranean origin. He briefly discusses the types of oceanic circulation in the North Atlantic, and concludes that there are corresponding meteorological conditions, and that the latter, in so far as they affect the succeeding summer, can be foreseen from the value and time of occurrence of the maximum salinities in the Irish Sea.

The intensive study of the plankton around the south end of the Isle of Man has been continued. The maxima of the diatoms and most other plankton groups were earlier in 1912 than 1911. Examination of the various forms of the diatom Biddulphia leads Prof. Herdman and his collaborators to regard *B. sinensis* and *B. regia* as two forms of the original species *B. mobiliensis*. Mr. Scott reports on the pelagic fish-eggs of this area, and Mr Jackson on the decapod larvæ.

Prof. Herdman and Mr. Riddell, in their report on the plankton of the west coast of Scotland, state that the phytoplankton, which was so widespread in July, 1909 and 1911, especially round Mull, seems in the last two summers, and particularly in August, 1912, to have become pushed back or restricted to the more land-locked waters by an unusual influx of characteristically oceanic organisms from the Atlantic, *e.g.* the copepods *Metridia lucens* and *Candacia armata*. It is suggested that in the Hebrides there is a definite connection between the presence of oceanic water containing the copepod Calanus in quantity and shoals of herrings, for large hauls of Calanus were, on several occasions, obtained at places where, either the night before or the night after, good catches of herrings were reported.

BRITISH FORESTRY.[1]

THE useful publication before us (though foresters have to mourn the death of its long-time editor) retains its high standard of excellence. At the annual general meeting of the society, instead of a formal address there was a discussion on the relation of forestry to agriculture, &c. It is sufficient to follow this discussion to see what a strong body of opinion exists amongst practical men—forest owners and foresters—in favour of a comprehensive scheme of national forestry. The conclusions arrived at in this discussion vary little from those expressed in the Coast Erosion report of 1908, and in the similar Committee reports that preceded it.

The average rental of hill grazing ground suitable for forest planting in the north-east of Scotland is not more than 1*s.* per acre. This fact opens up a great national question of the more profitable use of the land in these islands, which are themselves one of the most fertile and productive countries of the world. Then there is the question of small holdings. These are linked with forestry in the sense that they cannot generally exist under present conditions without the help afforded from winter labour in the forest. Looked at from a national point of view, the labour question means, in the case of grazing and shooting, two or three men employed per 1000 acres, against about 10*s.* per acre per year wages in forestry. The careful Prussian statistics give 11*s.* 4*d.* per acre per year as the average forest wages bill. About one man to fifteen is the grazing-*versus*-forest ratio given in the Coast Erosion Committee's report.

This rural labour, priceless from a national well-being point of view, is being lost to the country, and some 30,000,000*l.* is being sent out of the country yearly for timber and forest products which might be produced in these islands.

Says Mr. Munro Ferguson, commenting on the last forest Blue-book (Rept. of Advisory Com. on Forestry, Cd. 6713):—"While the Administration gropes its way in the dark, and while the paramount national interest of silviculture (as affording the widest scope for additional skilled labour on the land) is neglected, 3000 emigrants leave the Clyde weekly." Mr. Munro Ferguson was the first large forest owner in Scotland to bring his own woodlands under scientific management, and he has since then represented forestry in almost every capacity.

The full text is given of the address of Sir John Sterling Maxwell (the retiring president of the Royal Scottish Arboricultural Society) to the Aberdeen branch. This was summarised in the April number of the Quarterly Journal of the English Arboricultural Society. It may be looked on as the most important pronouncement, in favour of a comprehensive scheme of State forestry, that has yet been made by an influential owner of forests in these islands: It is well termed, "The Place of Forestry in the Economic Development of Scotland." No lover of trees, no one

[1] Transactions of the Royal Scottish Arboricultural Society, vol. xxvii. part ii., July, 1913. (Edinburgh: Douglas and Foulis.)

who wishes to see the scientific methods in vogue on the Continent brought to bear on the waste lands of these islands, should be without a copy of this illuminating address. It concludes with the statement that "the Belgian Government obtains on the capital it has invested in forestry a return varying from 4·9 to 5·5 per cent." In his retiring address as president (Proc., p. 10) he adds:—"Scotch forestry is in the toils of the serpent of red tape. In spite of our efforts to keep it free and independent, forestry is now entangled with a number of different departments, some of which in the nature of things can know very little, and perhaps do not care very much, about the subject."

Mr. B. Ribbontrop, who, for many years, was head of the Indian Forest Department, gives a summary of Dr. R. Albert's researches on the peat soils of north-west Germany.

The true character of the seedlings of Japanese larch raised from Scotch seed was discussed at last summer's meeting of the English Arboricultural Society. On one hand, the time (one generation) seemed too short for the environment to have altered so considerably the character of the seedlings. On the other hand, the alteration seemed to be too uniform for hybrids between *Larix europaea* and *Larix leptolepis*. Mr. A. Murray, writing from Murthly, where these seedlings have been closely watched from the first, now gives the opinion that they are not hybrids. It may be noted that a similar alteration has been remarked in the case of an Australian Eucalypt that had been one generation in southern France.

For extracting tree-stumps with gelignite, Dr. Lauder gives the following working formula:—For pine stumps, $\frac{\text{square of girth in feet}}{20}$ = cost in shillings of explosive; and for broad-leaved trees—oak, ash, elm, &c.—about double the cost of pines and firs.

THE MANUFACTURE OF ARTIFICIAL TEETH.

In the *Bulletin de la Société d'Encouragement* for April last is an interesting and well-illustrated article on "La fabrication des Dents Artificielles Minérales," by M. Maurice Picard, of the firm of MM. Henri Picard and Co., read at the opening ceremony of the first factory established in France, at Versailles, in the presence of M. Lechevalier, the representative of the Minister of Commerce and Industry.

The making of artificial teeth has for more than fifty years been a small but important industry in England and America, where millions of teeth of many shades and shapes are annually manufactured.

This industry owes its origin and early development to illustrious Frenchmen. Pierre Fauchard, in his work, "Le Chirurgien-dentiste," 1728, first suggested the use of enamel. Duchateau in 1744 substituted porcelain for ivory, with the aid of the porcelain manufacturer M. Gerrard, of Paris. Later Duchateau, with Dubois de Chaumant, a dentist in Paris, who suggested the addition of pipe-clay, made great improvements in manufacture. The latter carried the invention to England, and obtained a patent in 1791 for fourteen years. In 1808 Fonzi, a dentist in Paris, fixed platinum pins into the body of the tooth, as a means of attaching the tooth to the artificial plate which holds it in position. M. Plantou manufactured artificial teeth in America in 1817.

Felspar and silica ground to an impalpable powder, to which is added a certain amount of kaolin, form the basis of all porcelain teeth. These are made into a thick paste, and tinted in a variety of colours with oxide of titanium. The paste is pressed into moulds in which are inserted platinum pins. These teeth are then fused in a furnace at a very high temperature. The factory in Versailles already manufactures 225,000 teeth each month.

Incidentally, one may inquire why such an invention should not have found, sooner, an industrial home in the land of its origin? The answer may be suggested, not in lack of enterprise, but in the facts that French people do not readily part with their natural teeth, and they have an innate objection to artificial teeth on plates.

We have no doubt that the refined foods of an advancing civilisation are leading to an increased destruction of teeth by dental caries. We have no evidence to prove that our neighbours' teeth, however, are better than our own, but they submit more readily to the conservative treatment which dentists are trained to give in the preservation of teeth, rather than permit the ravages of the *arracheur de dents*.

R. D. Pedley.

THE MUTATIONS OF OENOTHERA.

The last decade has witnessed many remarkable advances in our knowledge of heredity and variation. The beginning of the present century may be said to mark the turning-point between the observational method of Darwin and the more intensively experimental method now pursued in the study of evolution. This change from observation to experiment in evolutionary study was participated in by many investigators. Among those whose work will ever occupy a prominent place in the renaissance of activity in scientific plant- and animal-breeding may be mentioned de Vries, whose theory of mutation, or the sudden origin of new species, has been a fruitful subject of investigation and discussion.

The views of de Vries, published in 1901, were based to a considerable extent upon his prolonged investigations with the evening primrose, *Œnothera Lamarckiana*. These now classic experiments showed that when this species is cultivated in large numbers, individuals appear sporadically but repeatedly year after year which differ from the type in nearly all their characters. These new types, or mutants, in many cases breed true, giving rise to new races, and the main facts of de Vries's observations have since been repeatedly confirmed.

It is safe to say that these remarkable and at that time unique observations have subsequently led to a more thorough and complete study of the evening primroses than has been accomplished in any other group of plants, not even excepting the garden pea of Mendelian fame. Numerous investigators have attacked the problem thus presented from many points of view, and much light has been thrown upon the general subject of mutations. This is particularly true of the cytological investigations, which have really furnished the key to the explanation of the mutation phenomena.

Since a fortunate discovery in 1906 indicated that various mutants differed in the constitution of their nuclei, the origin of these differences has been an absorbing subject of investigation. Two years later it was possible to show that a basis for changes in the nuclear constitution of different mutants exists in the germ cells, and that the process of mutation is probably in part a result of irregularities in chromosome distribution during meiosis or germ-cell formation. The chromosomes are the constituent parts of the nucleus, and their number is constant for each species, so this furnished the desired proof that, in some of the mutants at least, a fundamental change in the structure of the nuclei had taken place, and that the external changes of characters in mutation had their origin in internal structural changes of the cells and their nuclei.

The premutation hypothesis, formulated by de Vries to account for the origin of the mutations before the facts regarding their cell-structure were known, assumes that new units gradually accumulated in the germ plasm of the species previous to the beginning of the mutation process, and that these afterwards passed from a latent to an active condition, thus producing the mutations. But since the structure of the nuclei in these forms is now known, and the manner in which changes in that structure originate, this hypothesis has been superseded, and the conception of a mutation period is no longer needed.

Various writers have also suggested that the mutations of Œnothera were merely re-combinations of characters, such as occur in Mendelian hybrids. This hypothesis is also contrary to our present knowledge of the nuclear structure and behaviour in Œnothera, and furnishes another instance, like that of the sex-chromosomes, where nuclear studies throw light upon the nature of the processes of heredity and variation. By combining the study of nuclear and cell structure with that of external characters, it is evident that much further insight into the nature of mutation and heredity may be gained.

A specific case of the type of germinal change here referred to is that of *Œnothera lata*. It has recently been found that when combined with characters derived by inheritance from various other forms (*e.g. O. biennis, grandiflora and rubricalyx*), the characteristic foliage and habit of *lata* is always accompanied by the presence of an extra chromosome in the nuclei of the plant, making the number of chromosomes fifteen instead of fourteen. In other words, this type of foliage is constantly associated with the presence of an extra chromosome.

Mutations are by no means confined to the evening primroses, but are now known, through experimental studies, to occur in bacteria, fungi, mosses, and many flowering plants. And among animals, instances of sudden and inherited departure from the parent form occur in various groups from Protozoa to man himself.

The new characters thus appearing form a varied and motley array, differing often in most unexpected ways from their parent types. Many of these mutations appear "spontaneously," that is, from unknown causes. These are probably often an indirect result of previous crossing, change of climate, &c. Others have been directly produced by a variety of experimental conditions. The study of the causes of these germinal aberrations and the manner of their production is evidently destined to play an important rôle in future experimental evolution. The results already achieved point to a wide and important field of research in the application of these methods to horticulture, agriculture, and experimental breeding.

R. RUGGLES GATES.

OBSERVATIONS IN THE SOUTH MAGNETIC POLE AREA.

I BEG herewith to enclose what I trust will prove for the scientific world in general an important preliminary report by Mr. E. N. Webb, magnetician to Dr. Mawson's Australasian Antarctic Expedition, on the magnetic work, and particularly the absolute readings taken by Mr. Webb himself on a very fine journey made by him and Mr. J. F. Hurley, under the leadership of Lieut. Bage, in the direction of the south magnetic pole for the distance of 300 miles to the south-east of Dr. Mawson's base at Commonwealth Bay in Adélie Land.

You will see that a large number of very valuable observations have been obtained on the north-west side of the south magnetic pole area, and these, when considered with the observations—fewer in number but accurate—taken by Dr. Mawson himself on the occasion of the Shackleton expedition on our approach on the south-east to the south magnetic pole area, should now enable the position of the south magnetic pole in 1912 to be calculated with a degree of accuracy considerably in advance of anything previously attained.

I have ventured to add some notes in reference to the observations made by Dr. Mawson in the party—consisting of Dr. Mawson, Dr. A. T. McKay, and myself—of which I was leader in a journey to the south magnetic pole area in 1908–9. I send with it a plan on tracing cloth showing the route followed by the Australasian Antarctic Expedition, with the positions of the stations where Webb made his observations.

T. W. EDGEWORTH DAVID.

University of Sydney, May 26.

MAWSON'S AUSTRALASIAN ANTARCTIC EXPEDITION.

Preliminary Report on Magnetic Work, by E. N. Webb, Magnetician.

Early in December of 1911 the Australasian Antarctic Expedition, under the leadership of Dr. Mawson, left Australia to carry out a programme of scientific investigation on the Antarctic continent.

It was intended to conduct a magnetic observatory at one base station, and to make a magnetic survey of the coast between Cape Adare and Gaussberg. A large portion of this plan was successfully carried out. Through the kindness of Dr. Bauer, director of the department of terrestrial magnetism of the Carnegie Institution of Washington, D.C., the writer was trained during five months' field survey work in Australia, under Mr. E. Kidson, one of the department's observers.

Absolute instruments were lent by the Carnegie Institution, consisting of two unifilar magnetometers, one Kew pattern and one Lloyd-Creak dip circle, by Dover, Charlton, Kent, both fitted with 6 in. declinometer needles, and total intensity attachments.

Intercomparisons of all instruments with a set used by Mr. Kidson were made at Hobart before going south; also, the Eschenhagen magnetographs, comprising declination, horizontal and vertical intensity variometers, were set up under the direction of Dr. J. M. Baldwin, first assistant at Melbourne Observatory. Both the observatory and the field work at the main base were in charge of the writer. Field survey work was commenced at Macquarie Island, where determinations of the magnetic elements were made at two stations, one at the extreme north of the island, and the other at Caroline Cove. The average of determinations at the north end gave declination 18° 25′ E.; horizontal intensity, 0·13990; dip, 77° 47·8′ S. Leaving Macquarie Island, the expedition proceeded to Adélie Land, and at Commonwealth Bay in latitude 67° 0·0′ S., longitude 142° 39′ E., landed the main party. Here two magnetic huts were erected. In the larger, which was carefully constructed to resist wind and change of temperature, the magnetographs were set up with the frames on solid rock, and put in working order on March 21, 1912. Temperature-compensating systems were fitted to the H. and Z. variometers, and temperature effects have been almost entirely eliminated. Deflections were made once a fortnight for scale values.

In order to record the large declination changes (as high as 12°), a scale value of 2·25′ per mm. had to be employed, while the force ranges required a scale value of 8 to 10 γ per mm. The largest change in force occurred during an auroral storm, when a reduction of more than 1000 γ took place in horizontal intensity.

During the time of occupation a complete and accurate log of aurora was compiled. Between March and October, numerous displays were observed, varying from a dull nebulous glow low in the north to splendid designs of arches, curtains, and streamers vividly coloured in green, red, and heliotrope, far surpassing anything seen by Dr. Mawson in McMurdo Sound in 1908. The exact times of prominent phases were noted. A cursory comparison with the magnetograph records showed a remarkable coincidence of magnetic and auroral storms. The nebulous type of aurora seemed to have little accompanying magnetic disturbance, but when moving and coloured luminous bands scintillated across the sky, the phases of the accompanying magnetic storm would almost invariably be found to correspond to variations in form or colouring of the aurora. Three splendid displays in the evenings of July 4, 5, and 6 perhaps constituted the most brilliant series. There seemed to be some indication of a recurrence of aurora at definite intervals.

As previously arranged in a scheme of international cooperation, twenty-four special terms of two hours each were "quick run" on the magnetograph. These unfortunately proved wanting in incident, the most disturbed being that of April 16, 1912, when a fairly large movement was recorded.

From the end of March, 1912, to February 8, 1913, the magnetograph record is almost unbroken.

In the smaller hut absolute determinations of declination, horizontal force, dip, and total force were made once a week. The average values at the station were:—Declination, 6° 30′ W.; horizontal force, 0·0311 C.G.S.; dip, 87° 21·5′ S.

Observations often had to be carried out in winds of eighty to ninety miles an hour, and in a pitchy darkness, since the night hours were the only approximately calm ones magnetically.

As a check on the absolute hut station, an ice station was occupied during the winter in a cavern dug out of the glacier, half a mile distant. The difference between the two stations was trifling in all the elements. In the early spring Mr. Hannam was instructed in the conduct of the observatory, and later carried on all work there during the magnetician's absence on sledging journeys.

In early September, 1912, three reconnaissance parties were sent out. One full magnetic station was occupied 11½ miles south of winter quarters.

On account of the persistently furious gales, no start could be made on the long summer sledge journeys until the second week in November. Three main parties then got away, while a fourth was to move off in early December. Of these, one was to make a long journey east, and was provided with a theodolite trough needle for determining magnetic declination; a second was to explore the more adjacent eastern coast-line, and besides a three-inch theodolite with compass needle, carried a dip circle with two dip needles; a third party was to make a journey south along either a geographical or a magnetic meridian towards the magnetic pole; while the fourth, carrying a sextant and an improvised declinometer, was to make as far west as possible. All parties were to return not later than January 15, 1913.

The eastern coastal party, under Mr. C. T. Madigan, secured magnetic results at eight stations fairly distributed over 270 miles. Declinations were obtained with the 2-in. compass needle attached to the theodolite, and dips were determined with either one or two needles.

The third party, consisting of Lieut. R. Bage, (leader), J. F. Hurley (photographer), and E. N. Webb (magnetician), left winter quarters, Commonwealth Bay, on November 10, 1912, and was assisted by a supporting party. A 3-in. Cary theodolite was taken for astronomical observations, and for magnetic observations the dip circle with declinometer and total intensity attachment and four dip needles. Strong head-winds and heavy drift were met with throughout the following week, and, with heavy loads, the travelling, over *sastrugi* country, was very slow. On November 21, 67½ miles S. by E. from winter quarters, the supporting party left.

Magnetic observations indicated considerable local disturbance, so to get the advantage of a direct dip gradient to the magnetic pole, the magnetic meridian was followed as nearly as possible. In the course of the outward journey seven full magnetic stations were occupied at intervals of thirty to fifty miles, while, in addition, rough determinations of declination and dip were made at almost every camp.

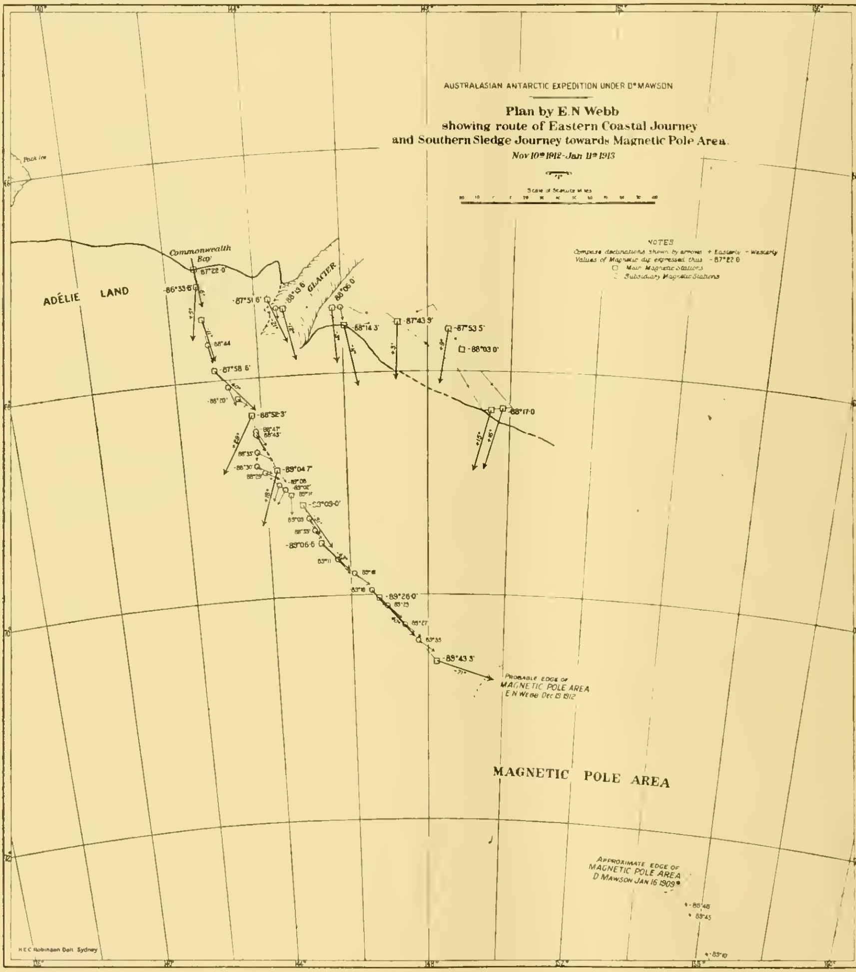
The observations at each full magnetic station comprised complete astronomical observations, observations of dip with four needles, double determinations with total force needles, and sixteen settings of the declinometer needle for declination. The declinometer trough needle proved an excellent instrument, even at the position of highest dip. Nearly all astronomical and magnetic observations were computed on the march as obtained.

For steering purposes on the journey a sun-dial or "shadow compass," computed for the sun's mean declination and equation of time, and the approximate mean latitude, was used. Granted clear weather, this is a very useful instrument. Steering south-east from the depôt, heavy head-winds were met with, the surface rising steadily and becoming rougher, with *sastrugi* increasing in size. At 100 miles and 174 miles out from winter quarters the party was held up by severe weather, but occupied itself with magnetic observations. Besides a full magnetic set at the 100 miles, a snow shaft 8 ft. deep was excavated, and a temperature gradient obtained, +9° F. at surface to −13° F. at 8 ft. At 174 miles a continuous observation of declination over twenty-five hours was made with the dip circle trough needle, the party living in a hole dug out of the snow.

On December 12 a depôt of food, oil, &c., was made at 200 miles. With the lighter sledge it was found that runs of from twelve to fifteen miles per day could be made. On December 21 the extreme station, 301 miles, was reached, at a height of 5900 ft. above sea-level, in latitude 70° 36′ S. and longitude 148° 12′ E. At most stations the magnetic meridian for dip observations was obtained by declinometer, but at this station dip was determined with four needles in two directions at right angles, and the meridian and true dip were thence computed; resulting dip, 89° 43·3′ S.; declination, 70° 49′ W.; total force, 0·6692 C.G.S. Between 200 and 300 miles out the surface was exceedingly rough, *sastrugi* 5 ft. high from trough to crest being met with.

Turning back on December 21, the first stages of the return journey were made more rapidly than had been expected, as much of the fresh snow had hardened. A depôt which had been laid at 200 miles on the out journey was picked up on December 27, and a full set of magnetic observations taken. During the remaining 200 miles almost continuous overcast weather obtained, making it extremely difficult to pick up snow-mounds built at almost every camp on the way out. The 109-mile mound was picked up, but the only other one seen was the ninety-mile. On reaching the locality of the sixty-seven-mile depôt, there were only two and a half days' rations on hand, and the ration was immediately reduced. Short marches were made in various directions, but the depôt could not have been seen 100 yards away, as light snow fell almost continuously. On the evening of the second day a fair latitude and longitude were obtained from altitudes of the sun. The party moved on to the computed position of the depôt, but could see nothing. Next day, after a long wait, a noon latitude was obtained, and a movement was made towards the supposed position of the depôt, but without success. Under these conditions, with but one day's ration in hand, it was decided to depôt all gear not essential to safety, and make a dash for the coast. The dip circle had to be left behind, but the needles were brought on.

The next two days continued heavily overcast, while a strong blizzard wind with thick drift was experienced. The third day was much brighter, and, with infinite relief, the party reached the depôt five miles from winter quarters just after midnight.



During the whole journey complete meteorological observations were made every two hours, and minimum temperatures were obtained at night. Altitudes were obtained by aneroids, standardised by a hypsometer.

The only life seen consisted of two snow petrels at eighty miles, and a skua gull at 125 miles, while no sign of rock was seen.

Longitude observations at three stations on the outward march were repeated on the return, so that the chronometer rate over three sections could be determined, giving good final longitudes.

Between 100 and 200 miles strong magnetic disturbance was evident. Declination chopped round by 90° in as short a distance as ten miles, while reversion of dip gradient was very commonly experienced. From 200 to 300 miles the declination was much more constant, and a steady dip gradient was observed. Continuing this last fair gradient, the 300-mile station was probably about forty miles from a position of maximum dip.

At the extreme western base 200 miles east of Gaussberg, and 1100 odd miles distant from the main base, magnetic conditions were better, but weather conditions were harassing. No magnetographs were provided, but periodic absolute observations were to be taken by the magnetic observer, Mr. A. L. Kennedy. Observations with magnetometer and dip circle were taken when possible. The station was situated on a floating glacier or barrier, and during the year determinations of the azimuth of the mark showed a progressive movement. During the sledge journeys—as far as Gaussberg in the west, and for 150 miles to the east—declinations were obtained at intervals with a prismatic compass, or with a declinometer attachment to a Lloyd-Creak dip circle. Two sets of dip were obtained on the eastern journey.

Term days were kept at the western base when possible by continuous eye readings of declination, while auroræ were observed and several observations of declination taken during active auroral disturbance. The accompanying plan shows most of the declinations and dips obtained. The possibilities of highly disturbed areas are illustrated by the anomalous declinations and dips about 100 to 174 miles. At 132 miles heavy crevasses were found, which seemed to indicate some unconformity beneath the ice-sheet.

Notes by Prof. Edgeworth David.

I have only just received by wireless some of the actual dips obtained by Dr. Mawson with a Lloyd-Creak dip circle other than those already published in Shackleton's work, "The Heart of the Antarctic."

First, at the Nordenskjöld ice-barrier, lat. 76° 14′ S., long. 163° 9′ E., the dip was found to be 88·1° S.; at the Drygalski Ice Barrier Tongue, in lat. 75° 28′ S., long. 163° 15′ E., the dip was 87·5°. On the Reeves Glacier, in lat. 74° 48′ S., long. 161° 30′ E., it was 87·9°. All these three sets of observations were very carefully taken. Again at lat. 73° S., long. 156° 10′ E., a careful set of observations showed the dip to be 89° 10′. The next observation, which may not be looked upon as quite so accurate as the others, gave the dip as 89° 45′, in lat. 72° 42′ S., long. 155° 40′ E., and the last observations, also of approximate accuracy only, indicated a dip of 89° 48′, at a spot thirteen miles to S. 30° E. of our furthest point to N.W., the latter being in lat. 72° 25′ S., long. 155° 16′ E.

When we reached the spot where we recorded a dip of 89° 45′, on January 15, 1909, Mawson concluded that as the rate of change of dip had considerably increased in the last twenty-five miles we were close to the edge of the area of the vertical needle. The evening of the same day, when seven miles nearer the south magnetic pole area, Mawson's measurements gave the dip as 89° 48′. On striking a curve, he estimated that the actual edge of the region of verticity was only about thirteen miles distant from where our dip of 89° 48′ was recorded. We had already travelled twenty-seven miles beyond the spot where the results of the *Discovery* observations had placed the south magnetic pole during 1902–3. Accordingly we determined to march on thirteen miles and put up the flag there, as being the edge of the area of the vertical needle. Our proceedings have already been described in vol. ii., "The Heart of the Antarctic," pp. 180–2. During these last thirteen miles we took no observations with the dip circle, the tripod of which we utilised as a mark to guide us back on our return march.

Mawson estimated that the position of our furthest point to the north-west was in lat. 72° 25′ S., long. 155° 16′ E. A short distance on our return from the spot considered to be the edge of the area of vertical needle, Mawson experimented with the horizontal needles of an ordinary prismatic compass and a Brunton transit instrument. While he considered both needles worked "dead"—that is to say if the compass boxes were twisted the needles followed them around—it was found that on tapping the boxes and making the needles spin, the more sensitive of the two showed a slight tendency for its south-seeking end to come to rest within the western hemisphere of the compass. Mawson felt satisfied at the time that even if we might not have been within the area of vertical needle, at the particular moment—about 3.30 p.m., on January 16, 1909—when the end of our journey was reached, we were still well within the region of the diurnal swing of that area. In view, however, of the recent remarkable observations by Mr. E. N. Webb, it seems doubtful whether there may not have been some local disturbing influences affecting Mawson's observations on the Shackleton expedition, such as Webb's map shows affected the magnetic observations of Mawson's present Antarctic expedition. Reference to the map will show that at several spots along their route declination varies to the amount of from 40° up to 69° within a distance of only a few miles, and the dip, in some places, lessened considerably, instead of increasing, as the magnetic polar area was approached. This suggests that it is possible that at our furthest point north-west we may have been on the edge of either a local pole, an "outlier" of the main south magnetic polar area, or on a local lobe of the magnetic pole area, or may even have been just outside an area of absolute verticity altogether. By how much, if at all, we may have been outside, can, of course, only be determined when all the magnetic results are reduced, and compared.

MEROË: FOUR YEARS' EXCAVATIONS OF THE ANCIENT ETHIOPIAN CAPITAL.[1]

On behalf of the University of Liverpool, and aided by the support of private benefactors, the lecturer has been at work for four years in scientifically uncovering the ruins of the once-famous Ethiopian capital. When his first expedition arrived upon the scene, there was little to suggest the great extent and interest of the city which has now come to light; in fact, only one wall and a few objects of sculpture were visible above the soil. Now, however, a number of temples, palaces, and public buildings have been laid bare; the walls of the royal city have been traced; and during the past season's work, from which the lecturer has just returned, a considerable portion of this enclosure has been excavated so that a visitor may enter by the city gate and walk along the ancient

[1] Summary of a discourse delivered at the Royal Institution on Friday, April 25, by Prof. John Garstang.

streets, turning right or left at will into the different buildings.

First amongst the greater buildings of the site is the Sun Temple, which is designed in a series of ascending ambulatories with stone-built cloisters, the sanctuary being found on the highest platform, in the middle. A contemporary representation of the building upon its own walls has enabled Mr. W. S. George, the able architect of the expedition, by comparison with actual measurements, to attempt a reconstruction. In character and situation this temple corresponded to the "Table of the Sun" mentioned by Herodotus. An even larger building is the Temple of Ammon, the main axis of which is 430 ft. in length; the high altar and the special enclosure for sacrificing animals, and other interesting features of the temple, are well preserved. Other monuments excavated include an extensive palace presumed to be of Roman period, two small temples, one of which was dedicated to a lion-deity, an ancient temple of Isis, later reconstructed, pottery kilns of Meroitic times, and several hundred tombs of the necropolis. All these features appear to have been outside the chief, or royal enclosure, and it appears that there is still untouched by the excavators' spades a much larger area than has yet been attacked, including the ancient township itself which abutted against the walls of the royal city. The explorer is of the opinion that without a substantial increase in the annual sum available for this work, which up to the present has been almost entirely privately contributed by a few generous benefactors, it will scarcely be possible to complete the undertaking even in ten or fifteen years.

For the last two seasons the excavation has been almost entirely concentrated upon the royal enclosure, in which remarkable discoveries have been made. In one of the royal palaces a hoard of gold treasure and ornaments was found; and the royal baths adjacent, which are on an extensive scale, illustrate in their details the character of the Meroitic arts better than any other features of the city.

Under the threshold of another public building, carefully buried in sand, amid the débris of a building, there was found a beautiful bronze head of Augustus, which is now permanently deposited in the British Museum. A short distance from the spot are the remains of a small temple of Roman style; and the lecturer believes that this bronze head of the divine emperor had once formed the cult object in this temple. Two passages from Pliny seem to have been overlooked by those who have discussed the possibility of a Roman occupation at Meroë. From these it would appear that the imperial soldiers under Petronius had not only reached Meroë, but had passed up the Nile a further 100 miles. During the past winter a bronze coin of Augustus and an increasing number of small objects were discovered, all of which tend to indicate that, for a brief time at any rate, Roman troops actually occupied the city. In this way the fact and circumstances of the discovery of the bronze head would be satisfactorily explained. When Augustus commanded the Roman troops to withdraw, the head was removed from the temple and carefully buried out of danger of violation.

Two main culture periods are traceable in the history of Meroë previous to the Roman occupation. The first was that of its foundation under King Aspelut and his contemporaries, about the seventh century B.C. In this period Egyptian influence in art is freely apparent. The second phase began with an influx of Greek ideas, which may be roughly dated to the third century B.C., corresponding to a record by the historian Diodorus of great reformations instituted by Ergamenes, who had himself been educated in Greek thought in the schools of Alexandria. It is the second phase which is the most striking in the history of Meroe, and most of the visible buildings and monuments of the site belong to this period. The Roman occupation left little permanent impress upon the civilisation of the locality, but previous and subsequent to the expedition of Petronius there must have been already some influence of Roman contact, which manifests itself in various ways.

Thereafter the history of Meroë became that of a local and somewhat barbarous civilisation, reflecting only faintly the Greek and Roman culture with which it had been earlier infused. A record of the fourth century A.D. tells us how it was sacked by a king of Axum; but as late as the seventh century it would appear that invaders from the same district (Eritrea) overran the city and threw the statues and pictures of the gods into the river.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—An important announcement was published on August 13, to the effect that the President of the Board of Education has appointed a Departmental Committee to inquire and report, after consultations with the bodies and persons concerned, as to the steps by which effect shall be given to the scheme of the report of the Royal Commission on University Education in London, and to recommend the specific arrangements and provisions which may be immediately adopted for that purpose, and as the basis for the necessary legislation. Sir George H. Murray, K.C.B., who was formerly at the Treasury, and later Secretary to the Post Office, has been appointed chairman of the Committee. The other members are Sir Amherst Selby-Bigge, Secretary to the Board of Education, Sir John Rose Bradford, Sec.R.S., Sir William MacCormick, Dr. George Franklin, Dr. Arthur Keith, Mr. John Kemp (one of the secretaries to the Royal Commission), and Mrs. Henry Sidgwick. Dr. Frank Heath, the other secretary to the Royal Commission, is appointed secretary to the Committee.

MANCHESTER.—The council of the University has appointed Dr. A. D. Imms to the newly created post of reader in agricultural entomology. Dr. Imms was formerly professor of biology in the University of Allahabad, and afterwards forest entomologist to the Government of India at the Imperial Research Institute, Dehra Dun. He will be in charge of the researches in agricultural entomology conducted under the scheme approved by the Board of Agriculture and Fisheries. The council, [illegible] assistance of a grant in aid from the Deve[illegible] Fund Commissioners, has provided special laboratory accommodation for these investigations, and will undertake the necessary provision for the work of the department.

A REUTER message from Melbourne reports that a pioneer colonist named Mr. W. Robbie has died at Ballarat, aged ninety-one years, and has bequeathed 30,000*l.* to Aberdeen University to establish scholarships.

THE vacancy in the directorship of the Agricultural College at Cornell University, caused by the resignation of Prof. L. H. Bailey, has been filled for the time by the appointment of Prof. W. A. Stocking, jun., as acting-director for a term of one year. Prof. Stocking is forty-one years of age, and has been a member of the faculty of the college since 1899.

THE Governor of Pennsylvania has, we learn from *Science*, approved the following State grants made at the last session of the legislature:—The Pennsylvania

State College, 248,000*l.*; University of Pennsylvania, 164,000*l.*; University of Pittsburgh, 80,000*l.*; and Temple University, 20,000*l.*, making the total State grant for higher education 512,000*l.* From the same source we learn that Franklin College, Indiana, has secured pledges amounting to 50,000*l.* for additional endowment. Three-sixteenths of this amount is from the General Education Board in the United States.

The Edinburgh Mathematical Colloquium was held during the first week of August in the mathematical department of the University. It was organised by the office-bearers of the Edinburgh Mathematical Society in response to a widely expressed desire on the part of mathematical teachers in England for a vacation course in the mathematical laboratory which Prof. Whittaker was instituting. In addition to five lectures by Prof. Whittaker on the periodogram and harmonic analysis, two other courses were provided. Prof. Conway, of University College, Dublin, lectured on the theory of relativity and the new ideas of space and time, and Dr. Sommerville, of St. Andrews, lectured on non-Euclidean geometry and the foundations of geometry. Nearly eighty members of the colloquium assembled from all parts of the United Kingdom, and two or three from Canada and the United States. The colloquium was in every way a great success, the novel features being the method by which Prof. Whittaker proposed to carry on the practical instruction in numerical evaluation of functions and the treatment of definite data. Each "student" sat at a specially designed desk for facilitating numerical work.

The calendar of the Edinburgh and East of Scotland College of Agriculture for the session 1913–14 has now been issued. It contains full details of the various courses of instruction which are now available in the departments of agriculture, horticulture, and forestry. The aim of the college is to supply such training in agriculture and the sciences underlying it as is indispensable to all who intend to gain their living from the land as owners, or tenants, or agents. The calendar gives full guidance as to the curricula for the B.Sc. degree in agriculture and in forestry, the college diploma in agriculture, and the college certificate in horticulture. Special note may be made of the new course in horticultural science, which will appeal to young gardeners who have served their apprenticeship in the ordinary way, but desire to make themselves acquainted with the scientific as well as the practical aspects of horticulture. Under arrangement between Ed[illegible]burgh University and the [illegible]ollege there is now [illegible]d at Edinburgh a course of training in forestr[illegible] preliminary course is intended specially for those who desire to get a knowledge of forestry for general purposes, and mainly from the practical point of v[illegible]w.

SOCIETIES AND ACADEMIES.

London.

Geological Society, June 25.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—Dr. F. **Oswald**: The Miocene beds of the Victoria Nyanza and the geology of the country between the lake and the Kisii highlands; with appendices on the vertebrate remains, by Dr. C. W. **Andrews**; on the non-marine Mollusca, by R. B. **Newton**; and on the plant-remains, by Miss N. **Bancroft**. The Miocene beds of the eastern coast of the Victoria Nyanza, south-east of Karungu, form a narrow zone (covered with black earth) at the foot of cliffs of overlying nepheline-basalt, and are only exposed in a few gullies. The whole series is conformable, dipping 8° north by west. 1 (Beds 1–12). An upper group (about 70 ft. thick) of grey and brown clays and shales, with occasional current-bedded sandstones containing terrestrial shells (Tropidophora, Cerastus), as also calcified tree-stems in the uppermost bed. 2 (Beds 13–25). A middle group (about 30 ft. thick) of red and grey clays, with white sandstones in the lower half. No bone-bed, but fragmentary Chelonian and crocodilian remains occur sparsely throughout the series. Persistent horizons are a travertinous marlstone (No. 14) containing Ampullaria and Lanistes; a thin sandstone (No. 16) yielding Hyracoid jawbones; and a gravel (No. 24) yielding teeth of Dinotherium, Protopterus, crocodile, &c. 3 (Beds 26–37). A lower group (about 35 ft. thick) of current-bedded sandstones and gravels passing down into clays and marlstones. A conglomerate of calcareous nodules overlies gravelly sandstones (No. 31) containing isolated bones of Dinotherium, Anthracotheroids, rhinoceros, giant tortoises, &c., indicating a Lower Miocene (Burdigalian) age, with Ampullaria, Cleopatra, and terrestrial shells (Cerastus). The vertebrate remains described by Dr. C. W. Andrews include Proboscidea, Hyracoida, Artiodactyla, Rodentia, and Reptilia, and fully support the suggested occurrence of Lower Miocene deposits on the shores of the Victoria Nyanza. A deposit of probably Pliocene age yielded a new (?) species of Elephas, also bones of antelopes and baboons. The non-marine Mollusca associated with the Miocene vertebrates are freshwater and terrestrial shells which all belong to existing species.

Paris.

Academy of Sciences, August 11.—M. J. Boussinesq in the chair.—M. **Baillaud** gave an account of the recent meeting of the fifth congress of the International Union of Solar Research, held at Bonn.—L. E. **Bertin**: Concerning the origin of the double oscillograph for the simultaneous registration of pitching and rolling of ships.—A. **Lacroix**: The cipolin marbles of Madagascar and the associated silicate rocks.—A. **Romieux**: An attempt at gehypsographical exploration.—A. **Guillet** and M. **Aubert**: The direct expression of electrospherical functions; formation of differential equations verified by these functions.—E. **Rothé** and M. **Guéritot**: A method permitting the use of apparatus on a reduced scale in wireless telegraphy.—Jean **Bielecki** and Victor **Henri**: The quantitative study of the absorption of the ultra-violet rays by some acids of the ethylene series. In the acids studied the double bond produces an increase in the absorption of ultra-violet rays, and this increase is the more marked as the position of the double bond approaches the carboxyl group. Geometrical stereoisomers present different absorptions.—H. **Giran**: The molecular weight of sulphur trioxide. By the application of Trouton's formula, as modified by M. de Forcrand, the molecular weight of sulphur trioxide has been found to be 80, that is the simple formula SO_3 of the gaseous anhydride.—J. **Bougault**: Phenyl-γ-oxycrotonic acid.—A. **Wahl** and P. **Bagard**: The microscopical examination of coals. The chief difficulty has been the choice of a suitable etching material for the coal sections; pyridine was used with success for bringing out details of structure.—L. **Lindet**: The influence of calcium chloride on the curdling of milk.

Cape Town.

Royal Society of South Africa, July 16.—The president in the chair.—R. **Broom**: Some fossil fishes from the diamond-bearing pipes of Kimberley. This paper describes three new types of Palæoniscid fishes now preserved in the McGregor Museum, Kimberley, for which the author erects two new genera—Disichthys and Peleichthys—and three new species—*Acrolepis addamisi, Disichthys kimberleyensis,* and *Peleichthys kimberleyensis.* The fossils occur on slabs of sandstone which were taken from the Wesselton and De Beers Mines, and from the absence of conspicuous sandstones in the Ecca beds of the vicinity, and the occurrence in another slab of *Chelyoposaurus williamsi,* they are in all probability of Beaufort age. Denudation has removed all trace of the parent rocks from the locality.—W. A. D. **Rudge**: The daily range of atmospheric potential gradient at Bloemfontein and the influence of dust storms. An account is given of observations at Bloemfontein between July and December, 1912, with a Bendorff recording electrometer. The values of the potential gradient at hourly intervals are given for the whole period, and curves showing the daily range of the potential gradient are given for selected cases. These curves show (1) the normal range on clear calm days; (2) that on days when some dust was observed; (3) that on very dusty days; and (4) some special cases. The normal curves are similar to those taken in other parts of the world, but those for dusty days show great differences. In class (2) the dust is present in quantity sufficient to keep the potential almost at zero whilst in (3) for a considerable part of the day there is a very strong negative potential gradient amounting to thousands of volts per metre. This negative result is caused by the clouds of fine siliceous dust raised by the wind, as has been shown by the author in previous communications. A negative potential gradient was never recorded unless dust was blowing or rain falling. Wind alone had practically no influence. The rain which fell during the period under observation was invariably negatively charged.—J. C. **Beattie**: Further magnetic observations in South Africa. Results of observations in various parts of South Africa during 1910–13. The greater number of the observations was carried out in the western Transvaal, British Bechuanaland, and Bushmanland. In addition a number of repeat stations were re-occupied.—J. C. **Beattie**: Magnetic maps of the western and northern parts of the Union of South Africa and of Great Namaqualand for the epoch July 1, 1908. Maps are given showing the true isogonics, the true isoclinals, and the true lines of equal horizontal intensity for the above region.—T. **Muir**: Note on Clebsch's theorem.

BOOKS RECEIVED.

The Microtomist's Vade-Mecum. By A. B. Lees. Seventh edition. Pp. x+526. (London: J. and A. Churchill.) 15s. 6*d.* net.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Lief. 47–53. (Jena: Gustav Fischer.) 2.50 marks each.

Le Froid industriel. By Prof. L. Marchis. Pp. 328. (Paris: Félix Alcan.) 3.50 francs.

A Plea for the Younger Generation. By Cosmo Hamilton. Pp. 63. (London: Chatto and Windus.) 2*s.* 6*d.* net.

Coast Erosion and Protection. By E. R. Matthews. Pp. xiv+147+32 plates. (London: C. Griffin and Co., Ltd.) 10*s.* 6*d.* net.

A New School Geometry. By R. Deakin. Part ii. Pp. viii+161–292. (London: Mills and Boon, Ltd.) 1*s.* 6*d.*

The Theory and Design of Structures. By Ewart S. Andrews. Third edition. Pp. xii+618. (London: Chapman and Hall, Ltd.) 9*s.* net.

General Chemistry Laboratory Manual. By Prof. J. C. Blake. Pp. x+166. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 8*s.* net.

The English Convict: a Statistical Study. By Dr. C. Goring. Pp. 440. (London: H.M. Stationery Office; Wyman and Sons, Ltd.) 9*s.*

A Text-Book of Biology. By Prof. W. M. Smallwood. Pp. 285+13 plates. (London: Baillière, Tindall, and Cox.) 10*s.* 6*d.* net.

Die Physik der bewegten Materie und die Relativitätstheorie. By Dr. Max B. Weinstein. Pp. xii+424. (Leipzig: J. A. Barth.) 17 marks.

The Principle of Least Action. By P. E. B. Jourdain. Pp. 83. (London and Chicago: Open Court Publishing Co.) 1*s.* 6*d.* net.

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" To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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THURSDAY, AUGUST 28, 1913.

PRACTICAL HYDRAULICS.

The Control of Water as Applied to Irrigation, Power and Town Water Supply Purposes. By P. A. M. Parker. Pp. vii+1055. (London: G. Routledge & Sons, Ltd., 1913.) Price 21s. net.

THIS comprehensive and authoritative work contains a wealth of matter relating to practical hydraulics which one might seek in vain for in any other published book on the subject. In the preface the author tells us that the book is the product of actual engineering experience, and is mainly based on a collection of notes and formulæ accumulated in some eighteen years of professional work, during the major portion of which he was engaged in independent practice, and that therefore it must be regarded not as a text-book, but rather as a manual for engineers in active work. He also remarks that, "although the initial knowledge assumed in the reader may be considered to be somewhat unusual, many portions of the book have stood the test of everyday office requirements in the hands of draughtsmen and assistants." And it is only fair to say that an examination of the work is entirely favourable to the author on these points, although, of course, in a work covering such a wide field, here and there are matters of a controversial character, which might be dealt with if the exigencies of space permitted.

The book contains the following chapters, namely: i., preliminary data; ii., general theory of hydraulics; iii., gauging of streams and rivers; iv., gauging by weirs; v., discharge of orifices; vi., collection of water and flood discharge; vii., dams and reservoirs; viii., pipes; ix., open channels; x., filtration and purification of water; xi., problems connected with town water supply; xii., irrigation; xiii., movable dams; xiv., hydraulic machinery other than turbines; xv., turbines and centrifugal pumps; xvi., concrete, ironwork, and allied hydraulic construction; (*a*) tables; (*b*) graphic diagrams. But these headings scarcely give an adequate idea of the scope of the book, as some of the chapters are divided into important sections. For instance, in chapter xiv. we have: section A, enlargements and contractions in pipes; section B, water hammer; section C, ejectors and syphons; section D, air lift and hydraulic compressor; section E, hydraulic ram; section F, resistance to motion of solid bodies in water; section G, impact of water on moving bodies. All of these are important subdivisions, and they appear to be handled in an entirely satisfactory and convincing way; but having regard to the title of the chapter, one looks in vain for any discussions on the piston-pump and Humphrey's pumps, the most important of all hydraulic machines. However, the hydraulic engineer has other books available in which these machines are fully dealt with, and the author was wise in confining himself to matters that do not so completely come within the province of the mechanical engineer.

Chapter vii., dams and reservoirs, is one of the best in the book; the 130 pages devoted to this important section will be appreciated by both designers and engineering students. A valuable feature of the work is that each chapter is prefaced by a list of its own symbols and a sequential table of an extremely useful character, and many of the chapters have also a summary of the equations and formulæ. The mathematics used in this lucid and most readable work are fairly easy, certainly to those accustomed to read works on hydraulics.

Another exceedingly valuable feature is the bibliography, as the book teems with references to original authorities; indeed, it is a standing testimonial to the author's patient and untiring labours. He is to be congratulated upon producing a work that will in all probability rank as high in connection with applied hydralics as Bellasis's work on hydraulics does in connection with theoretical questions; in fact, Mr. Parker's encyclopædic work is the most notable book of the kind that has appeared for many years, and it will probably become a classic. H. J. S.

SPHERICAL ASTRONOMY.

Lehrbuch der sphärischen Astronomie. By Dr. L. de Ball. Pp. xv+387. (Leipzig: W. Engelmann, 1912.) Price 20 marks.

DR. L. DE BALL'S excellent treatise shows abundant evidence of a long and careful preparation. From the nature of the subject striking innovations are not to be expected; it is rather in the minute details of the exposition that the merit of the present work is found. In some places the mathematical treatment has been simplified, in others the discussion has been made more rigorous and thorough. The author's long experience as a practical astronomer has led to improvements in all parts of the subject, little in themselves, but when taken together making a notable advance. According to the introduction, the book is intended to be both a text-book for students and a work of reference; it is in the latter respect that we commend it. Spherical astronomy is a rather heterogeneous collection of but distantly related problems, and a minute treatment of isolated questions, many of which are only required in special researches and have no general interest, makes a very unsuitable course of reading for the student. But for those who are seeking specially full information on any of the subjects dealt with, this work will prove a very useful aid.

The introductory chapters deal very concisely with interpolation formulæ, the chief developments in series, and the method of least squares (without any account of the error-function). A long chapter deals with the theory of the earth's rotation. This part is rather hard reading, owing to the great number of symbols introduced. It would, we think, have been worth while to set out the definition of each symbol on a separate line, in order that it might be more readily referred to; for the reader can scarcely carry in his head the meaning of all the symbols, and their definitions are scattered through a great many pages of the text. Another long chapter deals with refraction, and includes a discussion of the effect of water-vapour on the constant of refraction. The treatment of the great problems of fundamental astronomy, the determination of the equinox, the obliquity of the ecliptic, and the construction of a fundamental catalogue is most thorough and satisfactory. In the chapter on parallax it may be noted that the correction to the ellipticity of the earth is included as an unknown in the determination of the moon's parallax; this small illustration shows the author's practical acquaintance with his subject, for the two quantities are so closely related that it is not improbable that the best determination of the figure of the earth may ultimately be obtained from lunar observations.

We would strongly criticise the absence of all reference to the theory of photographic observations. Thus, whilst the effect of precession, parallax, aberration, and refraction on micrometer measures is fully discussed, the formulæ relating to their effect on photographic measures are ignored. The theory of the projection of the celestial sphere on a photographic plate is eminently a branch of spherical astronomy, and at the present day it is most constantly required by practical astronomers, yet the text-books persist in devoting their whole attention to the obsolescent position angle and distance, instead of to rectangular coordinates. Such an omission is misleading to the student, and it is a defect in a work of reference for the observatory. Much of geometrical astronomy consists in a perfunctory application of three formulæ of spherical trigonometry; but the theory of rectangular coordinates is a more difficult subject, and the observer could not generally work out for himself the necessary formulæ without guidance.

A. S. E.

RECENT BOTANICAL PUBLICATIONS.

(1) *An Introduction to Plant Geography.* By Dr. M. E. Hardy. Pp. 192 + 66 figures. (Oxford: Clarendon Press, 1913.) Price 2s. 6d.

(2) *The Living Plant: A Description and Interpretation of Its Functions and Structure.* By Prof. W. F. Ganong. Pp. xii + 478 + 178 figures. (London: Constable and Co., Ltd.; New York: Henry Holt and Co., 1913.) Price 15s. net.

(3) *Flowerless Plants: How and Where they Grow.* By S. Leonard Bastin. Pp. xi + 152 + 64 plates. (London Cassell and Co., Ltd., 1913.) Price 6s. net.

(4) *School and Home Gardens.* By W. H. D. Meier. Pp. iv + 319 + 159 figures. (Boston and London: Ginn and Co., n.d.) Price 4s.

(5) *Agronomy: A Course in Practical Gardening for High Schools.* By W. N. Clute. Pp. xvi + 296 + 195 figures. (Boston and London. Ginn and Co., n.d.) Price 4s. 6d.

(6) *Das botanische Praktikum.* Fünfte Auflage. By the late Dr. E. Strasburger and Dr. M. Koernicke. Pp. xxvi + 860 + 246 figures. (Jena: Gustav Fischer, 1913.) Price 24 marks.

(7) *Paläobotanisches Praktikum.* By Prof. H. Potonié and Dr. W. Gothan. Pp. viii + 152 + 14 figures. (Berlin: Gebrüder Borntraeger, 1913.) Price 4 marks.

(8) *Die palaeobotanische Literatur.* By W. J. Jongmans. Dritter Band: Die Erscheinungen der Jahre 1910 und 1911 und Nachträge für 1909. Pp. 569. (Jena: Gustav Fischer, 1913.) Price 26 marks.

(9) *Icones of the Plants of Formosa, and Materials for a Flora of the Island, based on a Study of the Collections of the Botanical Survey of the Government of Formosa.* By B. Hayata. Fasc. ii. Pp. 156 + 40 plates. (Taihoku: Bureau of Productive Industries, 1912.)

(1) THE compiler of this introduction to plant geography appears to be somewhat out of touch with the modern development of the subject from the ecological point of view. The work is apparently intended for school use, but one would have thought that the best method of approach would be to deal at some length with the conditions of plant life in general, instead of devoting to this subject only twenty pages towards the end of the book as the author has done, and to lay stress on the idea of plant communities rather than to plunge, after a brief glance at a few types of British vegetation, into the descriptions of the "main vegetations of the globe," which form the greater part of the book. However, these descriptions, though extremely condensed, are thoroughly readable and vivid, but it is very doubtful whether the author's method of

treatment is calculated to give the subject of plant geography much educational value in a school curriculum. Many of the illustrations are extremely poor. However, we may perhaps hope for a more adequate and better illustrated treatment of the subject in the more advanced book promised in the preface.

(2) Prof. Ganong has already laid students and teachers of botany under a debt of gratitude for his valuable and helpful manuals, and in the present work he has produced an attractive and stimulating volume which every botanical teacher would do well to obtain. It presents the clearest and most complete picture of plant life that has appeared for many years, and should do much to popularise the study of plants among that increasing class of readers whose needs are met neither by the standard text-books intended primarily for college students, nor by the unfortunately too common type of "popular" botany book the appeal of which is made by means of coloured plates with incidental letterpress, concerning the character of which the less said the better. Prof. Ganong combines in a particularly happy manner scientific accuracy, clearness of exposition, and literary style, such as make this book delightful reading, whether he is dealing with the deeper problems of physiology or with the most familiar aspects of plant life. The work is marked throughout by freshness and originality of treatment, and the diagrams and generalised drawings which he gives so freely will be of the greatest value to teachers of botany, apart from their primary object of enabling the "general reader" to understand the descriptions which they illustrate.

(3) Mr. Bastin has produced a thoroughly attractive and interesting work, well designed to serve as a first introduction to the study of the flowerless plants, with the aid of the more detailed books on the various groups. Unlike some other writers of popular nature-study books, the author aims solely at arousing the reader's interest by means of excellent photographic illustrations and simple but, so far as they go, accurate descriptions, and takes care to point out that the reader of books of this scope will find in the text-books of the specialist "the best possible friends, incomplete in themselves, but priceless as guides to those things which alone can be truly studied in the open air." Nothing could be more different from the explicit or implicit claims of various other "popular" botanical writers to have presented a full and sufficient treatment of the subject in their books. Mr. Bastin's work is admirably calculated to stimulate interest in the hitherto somewhat neglected groups—from the nature-study point of view—with which he deals, and the reader who wishes to proceed to a more detailed study will, at any rate, have nothing to unlearn, though one rather wishes that the author had included in his excellent work a list of suitable books for the further study to which this forms such an admirable introduction.

(4) Mr. Meier's book, though written primarily for American use, contains scarcely anything that will not be found of interest and value to teachers of school-gardening in this country, as well as to amateur gardeners in general, and this despite the fact that the author does not deal with generalities or with experiments. He has succeeded admirably in his attempt to give definite instructions for the arrangement, planting, and care of a fairly wide range of plants commonly grown in the house and garden, the difficulties met in cultivating each individual plant being considered one at a time, and definite directions given for overcoming them.

(5) The second half of Mr. Clute's book covers much the same ground as the work just noticed, but its scope is somewhat wider, and the first portion constitutes an excellent general introduction to botany. Many of the illustrations of familiar objects have a fresh appearance, owing to the author's very sparing use of figures copied from other works. Nothing could be more suitable as a general introduction to botany and horticulture than the lessons on soil with which the book opens, though this portion might perhaps with advantage have been expanded. The teacher will find much that is useful in the work, despite the fact that American examples and illustrations are largely used.

(6) The late Prof. Strasburger's well-known "Botanische Praktikum" needs no special recommendation to teachers and students of botany, to whom it is well-nigh indispensable, no other single book covering so much ground. In successive editions the book has grown in size until in the present one, the fifth, it has become perhaps unduly large for convenience in laboratory use.

The present edition differs from its predecessors mainly in the addition of a considerable amount of new letterpress and illustrations dealing with micro-technique, the general plan of the work remaining unaltered. It is an open question whether there is not rather too much general descriptive matter that would be more in place in a book intended for the study instead of the laboratory; but still, the tacking-on of more or less theoretical passages to the directions for practical work has decided advantages. The chief drawback to the plan is that it is somewhat difficult to know where the line should be drawn, and that a book of this kind tends to indefinite expansion in successive editions; this objection is to some extent met by the author's smaller book, the "Kleine botanische Praktikum," but since the student can obtain the necessary theoretical matter in the ordinary descriptive text-books, it would appear better to limit the scope of a practical manual to directions for actual laboratory work. The use of the copious index relating to technique is facilitated by its being printed on coloured paper in this edition, which will be welcomed by teachers and students of botanical microscopy as the best and most comprehensive treatise on the subject in existence.

(7) This little book opens up what is to a large extent a new field, and will be of the utmost value to students of geology and plant ecology, as well as palæobotany. Despite its small size it contains an immense amount of skilfully condensed information, and is mainly occupied by concise and clear directions for the examination of fossil and subfossil plant remains in coal, peat, clay, &c. The names of Prof. Potonié and Dr. Gothan are sufficient guarantee of the excellence of the major part of the work, which is concerned with the preparation and examination of fossil and subfossil plant remains generally, but special attention may be directed to the excellent section by Dr. Stoller dealing with the investigation of peat deposits from the ecological and phytogeographical point of view.

(8) The labour undertaken by Dr. Jongmans in compiling an annual bibliography of palæobotanical literature has evidently secured the approval and support which it deserved, though one may regret the delay in issuing the third volume of this work, containing the titles for the years 1910 and 1911, with a supplementary list of 1909 publications. The mere citation of titles, however, forms a small part of the work, occupying only forty pages of this volume; the remainder (more than 500 pages) is devoted to the indexing of the plants dealt with in some 800 books and papers, a few words being added in each case to indicate the general nature of the communication made concerning the plant named.

(9) The original plan of the "Icones Plantarum Formosanarum" was to publish in a long series of fascicles, extending over some fifteen years, a flora which should contain full descriptions of all plants found in Formosa. However, even in the first fascicle (1911) this plan had to be altered slightly so as not to exceed the grant made by the authorities, and accordingly only the new species were described, with notes on the others; and in the meantime a further reduction of the grant has unfortunately compelled Dr. Hayata to cut out nearly all references to species in this second fascicle. Even in this somewhat truncated form, the work is of the utmost value; the present instalment contains keys to the families, genera, and species, an enumeration of Formosan plants from Saxifragaceæ to Dipsaceæ, with their localities and geographical distribution, descriptions of new plants, and forty very fine plates. The total number of flowering plant species now known from Formosa is a little more than 3000. For the interesting conifer *Taiwania cryptomerioides* a diagnosis is given of the male flowers, which were first discovered in 1911; in its male flowers this genus shows marked general resemblance to Cunninghamia.

F. CAVERS.

OUR BOOKSHELF.

Einführung in die Spektrochemie. By Prof. G. Urbain. Uebersetzt von Dr. U. Meyer. Pp. viii+213+9 plates. (Dresden and Leipzig: Theodor Steinkopff, 1913.) Price 9 marks.

THIS book is a translation of the French edition which has already been reviewed in these columns. It is based on a course of spectroscopy given by the author at the Sorbonne, and will be found useful in this country to colleges taking a short course in the subject for advanced students.

The book contains an excellent and up-to-date account of the various methods used in the production of spectra. The descriptions of the methods employed are very clear and well illustrated with diagrams, and contain many laboratory details necessary to know in order to repeat the methods with facility, but which are generally omitted from text-books.

Following this, which occupies nearly half the book, are chapters on phosphorescence and absorption spectra. A final chapter is devoted to the analysis of spectra into series and the laws of series, in which the chief facts of the subject are clearly set forth.

A Galla-English, English-Galla Dictionary. Collected and Compiled by E. C. Foot. (Cambridge University Press, 1913.) Price 6s. net.

THE Galla are people living in Abyssinia from Harrar, on the east, to the Sudan frontier on the west, and from Wollo, in the north, down to the southern frontier. Some, too, live in British East Africa, and a detached tribe to the west of Witu, on the north bank of the Tana river. Mr. Foot describes them as "a most industrious, pastoral and agricultural people, who are also keen traders."

Mr. Foot has been studying their language since he went to Abyssinia first, in 1907, and the volume gives the results of his industry. As Sir John Harrington says in his introductory note, the dictionary should be of service not only in Abyssinia, but also on her frontiers with the Sudan, Uganda, and East Africa.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Radium-D and the Final Product of the Radium Disintegration Series.

A RECENT discussion in the columns of NATURE has raised the question of the existence of elements chemically and spectroscopically identical but differing from one another by a few units of atomic weight. Should the far-reaching generalisations of Soddy and of Fajans prove correct, the chemical elements will have to be regarded from an entirely different point of view, and the explanation of the periodic nature of their properties will have to be sought for in the recurrent character of the processes of radio-active disintegration. At present, however, some of the evidence on which those views are based is at least open to question. With the exception of radium, niton, and the parent elements—uranium and thorium—none of the thirty-four radio-active bodies have been isolated, and none of their compounds have been obtained in a state approaching purity. Their properties have only been inferred from their behaviour when mixed with very large amounts, comparatively speaking, of known elements, such as lead, thorium, and tellurium, and when it has been found impossible to alter the proportions of these minute traces of radio-active matter by the usual analytical processes, chemical identity has been inferred. Even admitting the extreme delicacy of radio-active methods of analysis, it might be questioned whether much can be deduced from the inseparability of such minute traces when present along with large amounts of closely related elements. More satisfactory evidence would be furnished if the chemical properties of an equilibrium mixture from a pure radio-active parent could be investigated; and since during the last few months some direct observations have been made on the nature of radium-D and its products it may be of interest to give a preliminary account of the investigation.

The source of the radium-D and its products was highly purified niton (radium emanation) which four years ago had been compressed into fine capillary glass tubes, liquefied, and used for the determination of the vapour pressures of the gas by Sir William Ramsay and myself. Each tube originally contained somewhat less than 0·2 of a curie of emanation, which, when liquefied by pressure, filled a volume of approximately 1/5000 cub. mm. at the sealed end of the tube. Three tubes of the precious material were kindly placed at my disposal by Sir William Ramsay. The emanation was allowed to decay under pressure, and subsequent microscopic examination showed that the liquid had transformed itself into a dark-coloured deposit of submetallic lustre, resembling somewhat a dried colloidal metal, and also into a colourless gas, viz. helium. The total mass of the solid deposit was hence of the order of 1/1000 milligram, and since it had decayed for four years it contained, in addition to the equilibrium quantities of radium-E and radium-F, about 15 per cent. of radium-G, the end point of the series, as well as traces of the branch series derived from radium-C_2. The tube was only weakly radio-active, but when laid on a photographic plate the impression produced by the β-radiation of radium-E corresponded exactly with the visible distribution of the deposit in the tube. By a suitable procedure the mercury sealing the open end of the tube was removed as completely as possible, and after pumping off the helium pure chlorine was admitted. At ordinary temperatures the submetallic deposit remained unattacked, but on gently warming it was seen to change completely into a pure white, apparently homogeneous, crystalline chloride. On heating *in vacuo* to 220° C., the chloride did not volatilise perceptibly, and the photographic impression it produced coincided with that obtained from the submetallic deposit. Hence the chlorides of radium-D, -E, and -G are not appreciably volatile under these conditions.

On introducing water into the tube it was seen that the crystalline deposit dissolved without decomposition, but was only slightly soluble. Even after warming in presence of about ten times its own volume of water only a small proportion of the total solid went into solution.

The chief object, however, of this experiment was to determine whether radium-G, the final product of the series, was similar in chemical character to lead, and also to find out if radium-D approximated closely in behaviour to its longer-lived descendant. That radium-G and lead are identical is supported by much indirect evidence, though no direct proof has been advanced. Now lead is an element which can be detected in very minute quantities by the delicate and characteristic microscopic test of Behrens, viz. by the formation of a characteristically crystalline triple nitrite with the nitrites of copper and potassium. The test is so delicate that 1/100,000 milligram of lead can be detected with certainty if the proper conditions are observed, and, moreover, by determining the number and size of the crystals in a drop of known volume the amount present can be approximately estimated. It was proposed, therefore, to apply the test to a known fraction of the radio-active matter in the tube and to see whether the amount of triple nitrite formed corresponded with radium-G alone or with radium-G + radium-D. The application of the test was complicated, however, by the discovery that the glass of the capillary, and, in fact, soda-glass in general, contained about 0·03 per cent. of lead, and that a detectable fraction of this lead could be dissolved out of the glass with nitric acid. By avoiding the use of strong acids and simply extracting the glass with water no perceptible amount of this element could be found in the concentrated extract. To be quite certain that no lead from the glass could find its way into solution by this procedure, the very stringent test was made of extracting 5 grams of finely powdered glass for some hours with water and testing the residue after evaporation to dryness. The glass used had at some previous time been exposed to the action of radium emanation, and was of a deep purple colour. No lead was found in the extract, though analysis proved its presence in the glass.

Other sources of error lay in the possible presence of lead in the mercury sealing the tube, and in the reagents used for the test. No lead could be detected in the mercury and the reagents were carefully purified beforehand. In order to carry out the test the capillary tube containing the radio-active matter was cut into two portions, a longer one containing most of the solution, and a shorter portion in which the undissolved crystals remained. The solution in the longer portion was allowed to evaporate on a silica microscopic slide, and one portion of the drop obtained was tested for lead by the triple nitrite test and another tested with potassium chromate. In both cases the presence of lead was indubitably proved, but the quantity present was small. The short end containing the crystals was then fractured and the fragments extracted with water to which a drop of acetic acid had been added. The evaporated extract which left a scarcely visible residue was intensely radio-active, and from its solution a minute trace of a dark-coloured sulphide was precipitated by sulphuretted hydrogen. This latter was separated by centrifuging the solution in a capillary tube, dissolved in a drop of nitric acid, and tested by the Behrens method. The drop yielded a copious crop of triple nitrite crystals, and the amount of lead present was estimated at 1/4000 milligram. Now in the whole of the disintegration products in the tube only about 1/7000 milligram of radium-G was contained, and, further, only a fraction of the total matter was used for the test. Hence it seems probable that radium-G and radium-D both form a characteristically crystalline triple nitrite identical with that formed by lead.

An attempt was made to determine what fraction of the whole of the matter originally in the tube was present in the drop tested, by comparing the β-radiation of the various portions, but no great trustworthiness could be placed on the measurements at the time, since the chloride of radium-E has probably a different solubility to the chlorides of D and G. In a few months' time, however, when the β-radiation of E has reached its equilibrium value a repetition of the measurements should lead to a definite conclusion. Hence, excluding the possibility of undetected sources of error, one must conclude that the slow change products of the disintegration of niton contain a body behaving like lead, and, further, that this body is either radium-D alone or a mixture of radium-D and radium-G. Thus the investigation, so far as it has gone at present, tends further to support the theories of Soddy and of Fajans. R. WHYTLAW-GRAY.

University College, London.

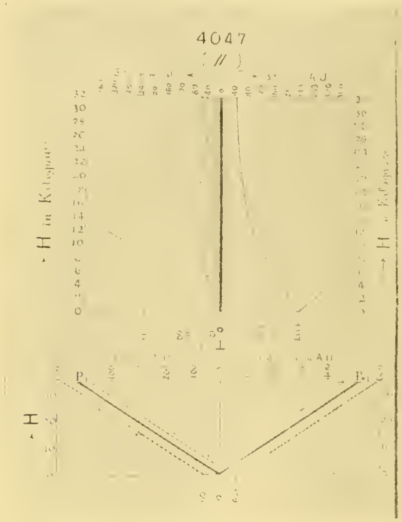
Anomalous Zeeman Effect in the Satellites of Mercury Lines.

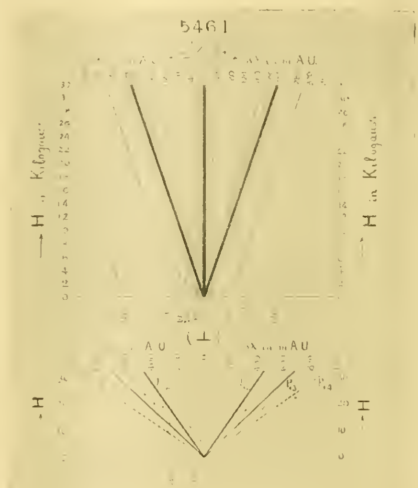
GEHRCKE and Baeyer, Lunelund, and McLennan showed that the satellites of some mercury lines are separated in a regular manner in weak fields; Gmelin found in the yellow line a satellite having anomalous character. Wendt noticed four characteristic lines in strong fields, but the satellites from which these lines proceed could not be identified.

Owing to extreme complexity in the distribution of lines when the field strength is increased, we have as yet no continuous observation indicating the position of satellites of mercury lines in different magnetic fields.

To fill in this gap, we made measurements on the satellites of the violet line 4047 and the green line 5461, up to the field of 30 kilogauss, and arrived at an unexpected result that the satellites show anomalous Zeeman effect, either as regards intensity or the mode of separation, and in nearly all cases both combined.

The instrument used was an echelon grating, but it was sometimes crossed with a Fabry-Perot air plate or a Lummer-Gehrcke plane-parallel plate to eliminate the false lines. From a large number of photographs





of transverse effects obtained in different fields, which were mostly uniform but sometimes heterogeneous, the positions of the satellites were plotted and traced into continuous curves; these are given in the accompanying figures, for components vibrating parallel and perpendicular to the field. The branches of the principal lines are indicated by P, and shaded to show the actual breadth; the positions of satellites in zero field are marked on the axis of abscissa by lines proportional to the intensity.

A glance at the figures for parallel components show that the separation is not generally proportional to the magnetic field. The satellites of 4047 are characterised by approaching the central principal line asymptotically, while in weak fields, the change in wave-length is quite rapid. The most remarkable of them is the satellite at -60 m.A.U. from the principal; the branch towards the positive side is approximately a parabola with vertical axis, and that towards the negative side a similar curve with horizontal axis; consequently the change wrought by magnetic field is proportional to $\sqrt{H}$ for the former branch, and to H^2 for the latter, showing that the singular case discovered by Gmelin is not confined to the satellites of the yellow line 5790. The same remark applies to the satellite -242 of the green line; the $(-)$ branch becomes fainter with increase of the field, and is parabolic in the sense above mentioned, the $(+)$ branch increases in brightness with the field, and the wavelength goes on increasing until it reaches a maximum, whence it gradually returns to the initial value in $H = 24{,}000$, and decreases farther at a constant rate. The $(+)$ branch becomes ultimately parallel to the principal line P_{-1}. The direction taken by this Branch ultimately coincides with that of the $(-)$ branch of the satellite, -74; on approaching the $(+)$ branch of -242, this $(-)$ branch of -74 becomes fainter, and is finally lost to view; the other branch of -74 runs probably parallel to P_{+1}, and increases in intensity.

The satellites -26 and $+78$ have both a curved branch towards the negative side, and a straight branch on the positive side, both being parallel to P_0. Thus in these lines the different branches to which the satellites are divided ultimately run parallel to the principal lines, whether the vibration takes place parallel or perpendicular to the direction of the magnetic force. This stage is reached earlier in the latter than in the former, as an inspection of the figures will show. The same holds good also for the strong satellites of the mercury line 4359. On reaching this stage, the change in wave-length takes place proportional to the corresponding change in magnetic field, and the separation becomes ultimately normal.

It is in the transition from zero field to this final stage that the separation of the satellite takes place in a singularly anomalous manner, that we seldom meet with in the separation of the principal lines.

This fact will have an important bearing on the elucidation of the nature of the satellite, and probably may have an intimate connection with the recent experiments of Paschen and Back. Before entering into theoretical speculation as to the probable origin of the anomalous mode of separation, we think it advisable to extend the investigation to see if such an effect is common to satellites of lines of other elements.

H. Nagaoka.
T. Takamine.

Physical Institute, Imperial University, Tokyo, July 31.

The Piltdown Horse "Grinder."

In the Dawson-Woodward paper on the Piltdown skull of a "hominid" (Q.J.G.S., vol. lxix.) mention is made of a tooth of *Equus*, and an accurate description (so far as it goes) is given. After handling it again at Kensington, and comparing it by measurements with recent finds from this Stort Valley, also with one recently placed in the Sedgwick Museum, and another in the Saffron Walden Museum, I have found that the tooth in question appears to be the *fourth premolar* (p.m. 4) of *Equus robustus*, which Prof. Cossar Ewart has recognised as the true "Solutré Horse" ("Restoration of an Ancient Race of British Horses," Proc. Roy. Soc., Edin., vol. xxx., part 4). The importance of this identification (if it is confirmed by experts) is too obvious to need further comment to those who are familiar with recent advances in our knowledge of the prehistoric horse. It remains to determine the exact horizon in the gravel-deposit at which this tooth was found before we can appraise its precise value as a time-index (see Nature, July 8, 1909, paper to the Royal Soc. by Prof. J. C. Ewart, F.R.S.). But one may venture to assert that the *stratum* of Piltdown gravel, from which this tooth of Equus came, is of far later date than anything belonging to the Pleiocene.

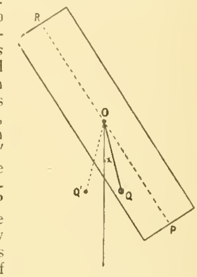
A. Irving.

Bishop's Stortford, August 16.

Automatic Stability in Aëroplanes.

Prof. Bryan's explanation of his model illustrating instability due to friction is somewhat obscure, but in any case it is difficult to see how there is not a violation of the principle of conservation of energy in his conclusion.

If θ and ϕ are the angles made with the vertical at any instant by OQ and OP respectively, the potential energy of the controlling mechanism is $k(\theta-\phi)^2$, where k is some constant.



When the system starts to move from the position depicted in the figure, its energy is $C + k(\beta-\alpha)^2$, and when it reaches the position of rest on the other side its energy is $C' + k(\gamma-\alpha)^2$, where C and C′ depend on the position of Q and Q′ relative to O, and therefore are equal, and β and γ denote the angles which OP makes with vertical in the first and last positions. Now Prof. Bryan states that γ is greater than β, in spite of the fact that some energy has been degraded by friction in passing from one position to the other. Where is his concealed source of energy?

J. B. Dale.

The system contemplated in my letter assumes the existence of an external source of energy, and perhaps it might have saved misunderstanding if this fact had been stated at the expense of brevity. If we imagine an aëroplane performing purely lateral oscillations, and suppose it furnished with a pendulum so arranged as to operate on a pair of ailerons, we have a system the action of which might be represented to a first approximation by the model assumed by me. In this case the necessary energy is being supplied by the wind, which, by its action on the ailerons, causes the aëroplane to rotate like a windmill during the interval that the pendulum rotates with the aëroplane, while the inclinations of the ailerons remain constant. The work done in a small displacement is of the form $k(\theta-\phi)d\theta$, but this does not integrate into an expression representing potential energy.

G. H. Bryan.

Physiological Factors of Consciousness.

I wish to ascertain the opinion of physiologists and psycho-physicists on the following point, and I hope some readers of Nature will be good enough to supply me with the information required.

My query is this: What is the true explanation of the fact that stimuli sufficiently strong to arouse vivid sensations in a subject while he is wide awake apparently fail to arouse any sensation at all in a state of unconsciousness? Four explanations appear to be possible, namely:—

(1) The afferent nervous current does not penetrate at all along the conducting paths into the central nervous system.

(2) It penetrates into it, but only up to a little way, and does not reach the highest nervous centres.

(3) It reaches even the highest centres, but simply touches them and does not enter them.

(4) It enters them, but fails to bring about that physical change in them that is the invariable concomitant of every conscious state.

The first of these explanations appears to me the least tenable of all. The last explanation, on the other hand, seems to be relatively the most probable. Indeed, on purely psychological grounds I am inclined to accept it as the final solution, but I must wait and seek an explanation on strictly physiological lines.

ABDUL MAJID.

Ghasiari-Mandi, Lucknow, India.

IN reply to your inquiry for information upon the question raised by Mr. Majid I beg to say that the view of the matter which is, I think, pretty generally accepted and which I have adopted and attempted to develop in several publications (more especially in a series of papers in *Mind*, vol. xv., "Physiological Factors of the Attention Process"), is that the central nervous system consists of series of sensor-motor arcs superimposed on one another to form strata of successively higher function from below upwards; that the synapses or cell-junctions of the higher level arcs offer higher resistance in the resting state than those of arcs of lower level; that the waking state is essentially one in which the generally diffused excitement of the whole system reduces these resistances of the higher levels to such degree that excitations from lower levels can penetrate them, such penetration being impossible in the quiescent state owing to the high degrees of resistance presented by the synapses of these higher levels.

Anæsthetic drugs (as I first suggested in *Mind* in 1898) seem to abolish consciousness through increasing the resistances of the synapses; and fatigue-products probably act on them in a similar manner, thus cooperating with diminution of external stimuli to the sense-organs in predisposing to or inducing normal sleep. I know of no evidence that points towards Mr. Abdul Majid's fourth type of explanation. His letter raises an interesting question, which is by no means settled, although the type of explanation I suggest is, I think, more or less tentatively accepted by a good many physiologists; and it would be of interest to elicit some expressions of opinion.

W. MCDOUGALL.

Oxford, August 7.

FOSSIL MAN.[1]

IN the summer of 1908 the Abbés A. and J. Bouysonnie and L. Bardon, already distinguished for their researches into the Palæolithic industries in France, made an important discovery. At La Chapelle-aux-Saints, a little south of Brive, in the Department of Corrèze, they found buried in a grave of Mousterian age a human skeleton of Neandertal type, with the head more completely preserved than in any previously known example of its kind. An inquest was held on the spot by some of the best-known "prehistorians" in France, who unanimously confirmed the observations of the discoverers. The skeleton, which Messrs. Bouysonnie and Bardon have generously presented to the National Museum of Palæontology in Paris, was entrusted by a fortunate choice to the director, Prof. Boule, and the result of his investigations is the beautiful monograph before us.

The first chapter is devoted to a history of the discovery. The skeleton was found lying in a hollow of the rocky limestone floor of the cave, and was covered by a magna of broken bones, worked flints, and yellow cave-earth, over which followed first a layer of clay and then of loose soil containing pebbles. Among the animals represented by the bones are the woolly rhinoceros, reindeer, bison, hyæna, marmot, and horse—a characteristic Pleistocene fauna. The implements are for the most part Mousterian points and racloirs; there are a few bouchers of Acheulean type, as well as some grattoirs which seem to presage the Aurignacian; but the assemblage as a whole is typical Mousterian.

The skeleton was orientated east and west, the head to the west. Above the head were the bones of a bison's foot (a metatarsal and some phalanges) still in connection—a proof that the deposits had not been disturbed, and suggestive of much else besides.

The skull (Fig. 1), of which a masterly analysis is given, is unusually perfect, and especially in

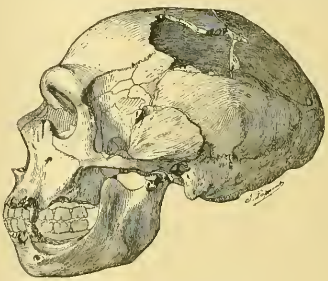


FIG. 1.—Skull of the man of La Chapelle-aux-Saints, with the nasal bones and the dentition restored (× ¼).

those parts which are absent from the Gibraltar skull, so that it is possible to determine the position of such important points of reference as the basion, opisthion, and bregma. The base is unfortunately incomplete, and this is the more to be regretted as the base of the Gibraltar skull, which in some respects is better preserved, presents some peculiar features not yet perhaps fully explained. In general there is a strong resemblance between these two skulls, the most marked difference, apart from size, lying in the extreme prognathism of the skull from La Chapelle-aux-Saints. Prof. Boule suggests that the orthognathism of the Gibraltar skull may be due to distortion consequent on pressure, but in the absence of collateral evidence we should be more inclined to regard it as an individual variation.

The most important characters of the skull are as follows: it is very large, especially for a man whose stature did not exceed 1·6 metres, and its capacity, measured directly by Flower's method, is 1620 c.c. The capacity of the Neandertal skull

[1] "L'Homme Fossile de la Chapelle-aux-Sainte." By Prof. M. Boule. Pp. 275+xvi plates. (Paris: Masson et Cie., 1913.) Price 50 francs.

is estimated at 1408 c.c., of La Quina at 1367 c.c., and of Gibraltar at 1296 c.c.

It is long, almost mesocephalic, and very flat: the frontal torus is enormous, the forehead low and retreating; there is a marked occipital torus, and the foramen magnum is situated far backwards; the squamosal is small, the mastoid process reduced, the tympanic slightly compressed, and there is a rudimentary post-glenoid apophysis. The palate is very large. The face has a remarkably brutal appearance, due partly to the retreating forehead and the frontal torus, the great round orbits, and very broad nose, but above all to the massive maxilla, which is without a canine fossa, and projects forwards, continuing the direction of the jugal, to form a sort of snout. The lower jaw is distinguished by the great thick-

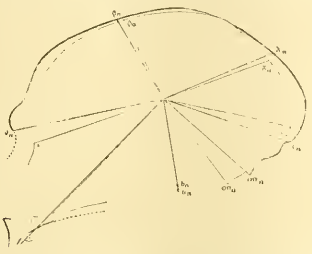


FIG. 2.—Profile of the skull of the man of La Chapelle-aux-Saints (thick line) compared with that of a low Australian aborigine (thin line). (The inions should be interchanged.)

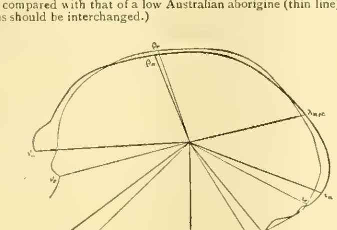


FIG. 3.—Profile of the skull of the man of La Chapelle-aux-Saints (thick line) compared with that of an average European (thin line).

ness of its body, the breadth of the ascending ramus, the obliquity of the symphysis, and the complete absence of a chin. The dentition is megalodont.

As the author justly remarks, it is not so much the occurrence of one or other of these characters which distinguishes the head of Neandertal man (many of them may be found scattered up and down among the members of some existing races); it is rather the association of all of them in one and the same skull, and, so far as we know, in all the skulls of one and the same race.

Very complete measurements are given, but exception might fairly be taken to the use of the glabella-inion line as a base; this is not without value when the Neandertal skulls are compared *inter se*, but it becomes misleading when the comparison is extended to the skulls of existing races. A better method is to superpose sagittal sections on a line drawn from the basion to the centre of form of its cranial area, as in the accompanying illustrations (Figs. 2 and 3).

It was found possible to obtain an internal cast of the skull, and thus to throw some light on the form of the brain, which, notwithstanding its magnitude, presents several simian features. It would be interesting to know what psychological significance may attach to these; Prof. Boule's

FIG. 4.—The skeleton of the man of La Chapelle-aux-Saints restored (× 15).

FIG. 5.—The skeleton of an Australian aborigine for comparison with Fig. 3 (× 15).

comment is that a small watch may be a better timekeeper than a big clock.

A minute description of the other bones of the skeleton brings to light a number of interesting peculiarities, as in the form of the scapula and the clavicle, the characters of the cervical vertebræ, and others which are summarised in a useful table (pp. 222–6).

In discussing the stature it is pointed out that Manouvrier's rules are founded exclusively on a study of existing white races, and that other factors have to be taken into account when we proceed to extinct races like the Neandertal. Prof. Boule is thus led to assign a stature of from

1·58–1·59 to the man of La Chapelle-aux-Saints, or even perhaps 10 mm. less. The attitude is regarded as having been less habitually erect than in recent races.

The numerous and important differences which we encounter in all parts of the skeleton are sufficient to distinguish Neandertal man from all existing races; he differs more from them than they from one another, and is therefore to be regarded as a distinct species, which, according to the recognised rules of nomenclature, should be named *Homo neandertalensis*.

All anthropologists will welcome the very interesting chapters on fossil Pleistocene man and the evolution of mankind which conclude the work. They are valuable not merely as a compendium of existing knowledge, but above all as an expression of Prof. Boule's personal opinions. We have not space to dwell on these, but we may briefly enumerate one or two points. No very close affinity is admitted between *Homo neandertalensis* and the aborigines of Australia; though they share many primitive characters in common, yet in still more they offer a decided contrast (Figs. 4 and 5). Pithecanthropus is regarded as a gigantic gibbon. The Mauer jaw is assigned to the Chellean stage. Some resemblance is recognised between the Grimaldi skeleton and the Bushmen, and it is admitted that the Aurignacian artists may have been the ancestors of this interesting people. No convincing evidence has yet been adduced of the existence of man before the Pleistocene epoch, and the so-called "rostro-carinates" are rejected.

The whole history of the discovery at La Chapelle-aux-Saints, from the exposure of the skeleton in its tomb down to its lodgment and reconstruction in the museum at Paris and the appearance of this monumental memoir, is a faultless record of skill and foresight. There are no lost opportunities to be regretted, and every significant fact that the material could yield has been elicited and set before us by a master hand.

THE AUSTRALIAN MEETING OF THE BRITISH ASSOCIATION IN 1914.

PROJECTED TOURS BEFORE AND AFTER THE MEETING.

BESIDES numerous excursions, in some cases over long distances, which are being arranged in connection with the meetings in the different capital cities of Australia next year, two more extended tours are projected with the object of giving selected members of the main party an opportunity to see portions of the continent which will otherwise not be touched. The first of these will be in Western Australia, and will be open to a limited advance party composed mainly of geologists, zoologists, anthropologists, and botanists.

The work of the party will lie in various directions from Perth. Geologists will be taken east to the goldfields, and also north to the Irwin River district. The geological relations of the latter (permo-carboniferous glacial beds with good exposures, and with excellent opportunity for collecting specimens) are more readily grasped on a short visit than are those of the goldfields. In addition an excursion will be arranged to Yallingup (south from Perth), and here there will be opportunity for botanists and zoologists to collect. For the latter, also, a marine excursion with dredging will be arranged at Bunbury on the return journey. A shorter trip by motor from Perth to Mundaring Weir will interest the same members, the zoologists visiting the region where Peripatus occurs. Marine dredging excursions in Swan River (for Ascidians), and by Rottnest Island, will also be arranged.

As regards the time that is required for a satisfactory working of the programme, a week is a minimum, and will mean much crowding and hurry. The Government of Western Australia and the committee in charge of matters connected with the visit would welcome a stay of a fortnight, and are prepared to grant railway facilities and find hospitality for that time. The number in the party must be limited, and membership restricted to people who are keenly interested in the work proposed. Twenty-five to thirty would be a convenient number, which might, perhaps, be extended to thirty-five, but must not exceed this.

The second tour would begin after the last meeting of the association in Brisbane, and the proposed itinerary is the following:—Brisbane viâ Rockhampton to Longreach by rail; coach to Winton; rail to Hughenden and Cloncurry; motor to Croydon and rail to Normanton. The party would then be taken to the mouth of the Norman river, and be met by the steamer belonging to the Administration of the Northern Territory (Dr. J. A. Gilruth, Administrator), and conveyed across the Gulf of Carpentaria, and about one hundred miles up the Roper river. They would proceed through the Territory by motor-car (there are no roads) to Pine Creek, and thence by rail to Darwin, where the steamer to England viâ Java, Singapore, and Colombo would be met.

A very considerable portion of Australia would be covered, and fine opportunities offered for the study of botany, geology, agriculture, &c., and, what is of great importance to Australia at the present time, the conditions of white settlement in the tropics. Obviously the party must be small, and it is suggested that it should include a botanist, a geologist, a zoologist, and a physiologist, or persons connected with mining, agriculture, and the development of Empire. Four would be a suitable number, or at the most five. Representative men only would be acceptable, for the trip will be costly; but if a party of sufficient standing and enthusiasm be prepared to undertake it, the Hon. D. F. Denham, Premier of Queensland, has promised, on behalf of his Government, to bear the expenses of the Queensland section, and the Administration of the Northern Territory will be responsible for the later section. A rough estimate of the time that might be spent on the whole trip is one month, but this would need to be adjusted in accordance with the time-table of the boats from Darwin to England.

It is hoped that both of these parties may be arranged by about the middle of November, while the organising secretary for the Australian meeting (Dr. A. C. D. Rivett) is in England. Inquiries should be addressed to the Secretary, British Association, Burlington House, Piccadilly, W.

TWENTY-FIVE YEARS' WORK AT THE PHYSIKALISCH-TECHNISCHE REICHSANSTALT, CHARLOTTENBURG.

THE Physikalisch-Technische Reichsanstalt, which may be aptly termed the German "National Physical Laboratory," plays such an important part in physical science that it may not be without interest to readers of NATURE to indicate briefly a few of the more prominent questions which have been dealt with at the institution since its foundation in 1885, which, by the way, was due in great measure to Werner von Siemens. Considerable information is afforded in two articles[1] recently published by members of the staff, and these papers should make interesting reading to those desiring further particulars of the work.

In addition to carrying out research work of direct interest to science and industry, the Reichsanstalt carries out the verification against standards of all kinds of instruments in the same manner as does the National Physical Laboratory in this country. It is, however, the research work to which we will confine ourselves here. The remarkable growth in the activities of the institution has kept pace with the advancement in scientific research during the last quarter of a century.

Dealing first with heat, the Reichsanstalt has occupied itself with practically every question in this branch of physics. One of its first tasks after getting into working order was the continuation of Regnault's famous work: he had shown that the scale of the mercurial thermometer could not be used as a standard owing to the influence exerted on the readings of the instrument by the expansion of the glass tube, the indications differing considerably in the range above 100° C. with thermometers made of different sorts of glass. Great difficulty had been experienced in finding a glass suitable for high temperatures when the Reichsanstalt commenced operations. Schott and Genossen, of Jena, experimented with different types of glasses and produced thermometer tubes constructed of new types of glass, and the Reichsanstalt tested these tubes as regards their accuracy over the fundamental interval 0–100° C., and their suitability for higher temperatures. The result is that the well-known Jena 59 quality has up to the present proved the most suitable in respect of small thermal expansion and of robustness. Extensive comparisons were afterwards carried out between the mercury thermometer and the air thermometer, owing to the difficulty experienced in realising the hydrogen thermometer scale at temperatures above 100° C. These measurements were carried to 500° C. At the present day nitrogen-filled thermometers are recognised as the most practical for high temperatures, and their success is to no small degree due to the labours of the Reichsanstalt. The institution has also played a not inappreciable rôle in the development of pyrometry, from the introduction of the thermo-couple by Le Chatelier to the more recent progress which resulted in the introduction of radiation pyrometry, based on the early observations of Becquerel, and on the later investigations of Kirchhoff and Wien on the subject of "black body" radiation. Following on Regnault's experiments, the Reichsanstalt has carried out research on the thermal properties of substances: this included experiments on the expansion of water between 0° and 100° by the communicating tube principle, and the determination of the saturation pressure between −60° and +370° C. The determination of the specific heat of gases—a question of high importance in internal combustion engine work—has been carried out with nitrogen, carbonic acid gas, and water vapour up to 1400° C., thus completing the work of Le Chatelier and Mallard in this connection, and the determination of the specific heat of gases at low temperatures has been made by Callendar's continuous flow method, improved by the counter-flow principle.

The electrical side of the work is no less interesting, and the activities of the institution have kept pace with the unceasing progress of this all-embracing science. It is, of course, of prime importance that the electrical units of measurement should be defined and realised as accurately as possible, and in this connection the Reichsanstalt has taken part in international conferences dealing with the subject, as well as cooperating with the State laboratories of other countries in carrying out measurements. Mercury copies of standard resistances had been found to be inconvenient in practice, and resistance boxes of German silver had proved inconstant and shown the resistance to be an intimate function of the temperature. It was Weston, in America, who first paved the way to improvement in this respect by inventing an alloy which showed but slight change of resistance with temperature; but it was left to the Germans to improve on Weston's discovery, the result being the introduction of the alloy (copper eight parts, nickel four, and manganese twelve) known universally as "manganin." Twenty years' experience at the Reichsanstalt with manganin resistances has shown the material to be unsurpassed by any other.

At the time the Reichsanstalt was founded standard cells were scarcely in use: it was only in the 'nineties that the Reichsanstalt, as the result of investigations, produced a practical standard cell, and one capable, moreover, of undergoing transit. This cell has, however, been superseded by the well-known Weston normal cell, which was accepted as the standard of e.m.f. by the London

[1] "Die Physikalisch-Technische Reichsanstalt: Fünfundzwanzig Jahre ihrer Tätigkeit." By Profs. Scheel, Holborn, Jaeger, and Brodhun. *Die Naturwissenschaften*, 1913, Nos. 8, 10, 12, 14.
"Die Physikalisch-Technische Reichsanstalt in Charlottenburg." By Prof. Karl Scheel. *Akademische Rundschau*, January, 1913.

conference on electrical units and standards (1908).

For direct-current measurements in electricity the three fundamental units—the ohm, the ampere, and the volt—are sufficient; but the Reichsanstalt experiments have contributed to a great extent to the improvement and simplification of methods of measurement. It was this institution that helped largely in the development of the potentiometer, which, in conjunction with the standard cell, forms the real basis of very many electrical measurements.

Mention should also be made of the "artificial loading" method introduced by the Reichsanstalt (separate circuit for current and pressure), which enables tests to be carried out, with but a small expenditure of electrical energy, on apparatus intended for the measurement of outputs up to many thousand kilowatts. It was also the Reichsanstalt which introduced the optical method of measuring current densities by means of the optical pyrometer.

Considerable interest attaches to the testing of sheet-iron employed in dynamo and transformer construction, and endeavours have repeatedly been made to keep down the energy losses in the material while augmenting the permeability (magnetisability) of the iron as much as possible. The Reichsanstalt was the first to suggest the use of iron alloyed with silicon for this purpose; and the researches of Barrett, Brown, and Hadfield appear to show the great advantage of this alloyed iron, which results in the reduction of eddy currents.

The optical work of the Reichsanstalt is not discussed quite so fully as that of the other branches. After a mention of pre-existing units of light, a space is devoted to the amyl acetate lamp of Hefner (briefly, the Hefner lamp) as a photometric standard. Whilst recognising its many advantages the Reichsanstalt has not lost sight of its deficiencies, and for this reason has always endeavoured to establish a measure of light to satisfy the broadest requirements of scientific and technical practice. Successful experiments have been conducted to secure a constant radiation of light from incandescent platinum with the aid of the bolometer, and tests now in hand justify the hope of arriving shortly at a mode of realisation of the "black body" which will fulfil all requirements in regard to accuracy and trustworthiness. Through the labours of the Reichsanstalt Germany was the first country to possess a generally recognised, accurately investigated unit of light.

The Charlottenburg establishment has also kept in close touch with practical requirements connected with saccharimetrical work. For ascertaining the value of sugar use is made of its rotation relative to the plane of polarisation, the Germans (and many other countries) using the Ventzke scale of divisions for the saccharimeters. The hundred point of this scale is defined by the rotation of a standard sugar solution (26 grammes in 100 c.c. of water at 20° C.) in a 20 cm. tube. For checking the readings of this apparatus, a quartz plate ground perpendicular to the axis is employed. Extensive experiments had to be made on the rotation of the pure sugar at the concentration of the standard solution, in order to arrive at a basis for test purposes. Great accuracy is necessary, as it is estimated that an error of 0·1 per cent. would make a difference in the sale value of the annual production of sugar in Germany of about 25,000*l*. The Reichsanstalt has, in addition, introduced the Abbe refractometer for determining the percentage of solids or of dry substance in connection with the impure sugar solutions to be investigated in the course of manufacture. Particulars are given of the method employed. Experiments have also been undertaken on the refractivity of other substances with the Abbe-Fizeau dilatometer, such as the refraction of different gases (air, H, N, and He) at room temperature and at very low temperatures; in addition, accurate measurements have been made on the refractive power of quartz and fluorspar—substances of such great importance in radiation measurements.

A series of optical experiments on metals have been made, yielding important results. The reflecting power was first determined by measuring the quantity of light reflected nearly perpendicular (to within $\frac{1}{4}°$) to the surface, for light of different wave-lengths, not only for the visible part of the spectrum, but also for ultra-violet (to wavelengths of $0·25\mu$) and for ultra-red rays (to wavelengths of $1·5\mu$). In the visible range the work was carried out with the spectrophotometer, and in the invisible range with a Rubens thermopile. In addition to pure metals the technically important mirror-alloys were investigated, and, for the visible range, glass mirrors coated with silver and mercury amalgam. It is interesting to note that silver, which in the visible spectrum reflects better (viz. 90–95 per cent.) than all other metals, reflects much less than all other metals in an ultra-violet region (between $0·25$ and $0·3\mu$), namely, only about 4 per cent.—or less even than a quartz surface.

An apparatus has been constructed by the Reichsanstalt for producing sharp interference bands, and having a high capacity. Its main constituent is a plane-parallel glass strip into which the light to be tested is transmitted in such manner as to fall on the bounding planes near to the angle of total reflection, thus emerging striated. With this apparatus a number of spectrum lines, particularly the mercury lines, have been tested as regards their structure and the presence of accompanying lines ("satellites").

In conclusion mention should be made of a series of experiments relative to the luminous phenomena in highly evacuated Geissler tubes. A new kind of ray, similar to the kathode rays, was discovered which was emitted from the anode under certain conditions. These anode rays, which are emitted in particular from hot salt anodes, show magnetic and electric deflection like the kathode rays and the Doppler effect (displacement of the lines in the spectrum). They were conceived as being positively charged metallic atoms of the salts contained in the anode, and are cast off from the anode at great velocity (100 to 1000 kilometres per second). Difficult measurements carried out have had reference to the velocity and to the ratio of the electric charge to the mass of a luminescent particle for different metals. Views, corroborated chiefly by spectroscopic tests, make it probable that the anode rays are identical with the sun's protuberances—that the latter are nothing but anode rays of gigantic dimensions.

The annual report of the Reichsanstalt for the past year, just to hand, gives evidence of continued progress in the various branches of scientific investigation, but space will not permit of touching on the subjects dealt with: readers are referred to the *Zeitschrift für Instrumentenkunde*, March, April, and May, 1913, in this connection.

E. S. HODGSON.

DERIVATION OF POWER FROM TIDAL WATERS.

THOUSANDS of years have been required to evolve the processes by which the energy stored by natural agencies has been made to fulfil our requirements; thousands of years may still be required to evolve processes by which the internal heat of the earth, the phenomena attendant on barometric pressure, and the potential energy of the tidal wave may be similarly utilised.

But with regard to the latter much has in reality been already achieved. Vast fleets of barges and shipping are daily carried to and fro by means of the tidal stream in estuaries and the mouths of rivers. Ships of all sizes are lifted and kept afloat in inland tidal basins. London, Cardiff, Bristol, and numerous seaport towns illustrate the fact that ends impracticable by other means may be attained by the utilisation of the tidal wave; and there is little doubt that as time goes on, the advantages to be derived from the utilisation of the tides in dock work will be manifested by even greater and more important works than have yet been undertaken.

Why, then, should it generally be considered impracticable to utilise some small portion of the potential energy of the tidal wave in the production of energy for other useful purposes? The answer to this question is difficult to find, but it appears that about forty years ago an attempt was made to investigate the matter. An analysis of the initial cost and probable revenue from a tidal installation was made the subject of articles in *The Engineer*. The result of the analysis showed that electricity could be produced at a cheaper rate with gas engines than by a tidal installation. The cumulative result of this weighty opinion was evidently far-reaching, and for many years only half-hearted attempts have been made to prove that the tidal installation is no longer to be considered outside the range of practical engineering problems.

The conditions which obtained forty years ago are no longer in existence. The improvements in plant for carrying out large works are so great that they are difficult to realise. The hydro-electric installations in those days were so few in number and so unimportant in effect, that the vast works which have been executed in the past few years would likewise have been considered impracticable from a commercial point of view, or, at the best, in the light of doubtful experiments. Even so late as 1904, in a paper read before the Institution of Civil Engineers (vol. clvii., session 1903–04, part iii.), Mr. Steiger gives it as his opinion that water power has been chiefly used for driving flour mills, and as the authority of the author is above dispute, it may be safely concluded that an analysis made forty years ago should no longer be allowed to stand without revision.

Perhaps the most important modification of the conditions which obtained until quite recently is the use of ferro-concrete as an auxiliary to the formation of embankments. The strength and durability of structures, such as bridges and landing stages, with struts and braces of ferro-concrete has proved the possibilities of that material in braced structural work, while the small section and great length of ferro-concrete piles has shown the possibility of handling suitably designed beams and girders of this material without risk of injury to them.

Now by constructing braced trestles which can be handled by a crane, and placed so accurately in position that slabs of ferro-concrete, designed for the purpose, may be set between them and fixed, an extremely economical shell may be formed to serve as the matrix of an earthwork embankment.

The present writer has had the privilege of making an exhaustive investigation into modern methods of forming sea walls, wharfs, breakwaters, and other sea works of that kind, and he is in a position to state that where there is no danger from the action of heavy seas, great economy can be effected by forming the face of a sea wall with a skin of concrete slabs, held in position by trestles of the same material.

But even with the saving which can be effected by this method of construction, the tidal installation is only practicable from a commercial viewpoint when the initial cost can be reduced to between 40*l*. and 50*l*. per horse-power; or, stating the matter in another way, unless the sum of the maintenance charges, plus about 10 per cent. on the capital outlay, divided by the capacity of the installation in horse-power, does not exceed 4*l*. per horse-power year.

The financial side of the question is of the first importance, but the difficulties to be overcome on the technical side are also, it is to be presumed, regarded as nearly insuperable as well. To deal with the latter it is necessary briefly to consider the general characteristics of tidal waters in estuaries or similar locations, and to indicate the methods proposed for overcoming them.

When the tidal wave passes from the open sea into the funnel-shaped entrance of a channel or estuary, its volume being constant, the height of the wave increases as the opening narrows, and the particles of water composing it acquire a horizontal motion. In fact, the tidal wave, after entering an estuary, may be considered to be a stream, which, while the crest of the wave is passing, becomes quiescent for a time, and then flows in the opposite direction until the trough of the wave, in its turn, causes another period of quiescence. These periods of quiescence are called the tidal intervals.

Now it has been found that the potential energy of a river may be converted to useful energy by damming the stream at a convenient place to obtain a working head for turbines; the difference in level of the stream above and below the dam being but a few feet. The economy of this method of generating electricity has been established by experience, and it is clear that if the utilisation of the tidal stream could be effected on somewhat similar lines, similar results might reasonably be expected. This in effect constitutes the problem which has to be solved.

The chief difficulty which has to be surmounted in utilising the tidal stream for power purposes is the tidal interval, and this difficulty must be considered as a problem to be solved for every location. In one case it might happen that it would be found cheaper to form one tidal reservoir and another reservoir inshore above the level of the highest tide.

The inshore reservoir would be filled twice daily by means of pumps actuated by the tidal reservoir, to serve as the supply to an ordinary hydro-electric installation which could be operated when required. In another case it might be found that the difficulty could be best dealt with by forming an auxiliary reservoir at a convenient spot higher up a neighbouring river, thus providing a separate unit to carry the load over the tidal intervals. In another case, again, it is possible that the intermittent operation of the turbines would not be found inconvenient. But speaking generally, the difficulty can be surmounted by the formation of two or more reservoirs connected to the tide and to a central turbine chamber by means of sluice valves; the feed to the turbines springing alternately from the main tidal stream and from the reservoirs in such a manner that a working head of water might be continuously maintained.

But it cannot be too strongly insisted upon that the first requirement for a tidal installation is a suitable site, the peculiarities of which will determine the character of the system adopted. For, since the success of such an undertaking depends on the cost per unit of power for structural work and equipment, it is evident that advantage must be taken of every favourable peculiarity, and that the system adopted will be dependent on the site.

In a case where the tidal interval is to be bridged by means of three tidal reservoirs the sequence of flow between the reservoirs and the tidal way is somewhat difficult to follow, but may readily be understood from the tabular description below. The three reservoirs are severally denoted by the letters "a," "b," and "c."

The tide rising from low water to one-third of its range:—

"a" Turbines fed from reservoir	"b" Standing empty	"c" Emptying into the tidal way

The tide rising from one-third of its range to high water:—

"a" Filling to high-water level	"b" Empty	"c" Turbines fed from the tidal way into the reservoir

The tide falling from high water to one-third of range:—

"a" Standing full	"b" Turbines fed from the tidal way into the reservoir	"c" Filled up to tide level

The tide falling from one-third of its range to low water:—

"a" Full	"b" Emptying to low-tide level	"c" Turbines fed from reservoir

It has been practically established that the basis of calculation for the power of a tidal installation should be one-third of the range of the minimum tide; hence when high tide is reached, water flowing from the tidal way may be passed through the turbines into the empty reservoir "b," the capacity of which must be such that the water level inside will have risen to the height of one-third of the range of the tide when the tide has fallen that distance. Similarly at low tide, water impounded in reservoir "a" to the level of the last high tide may be discharged through the turbines into the tidal way, the capacity of reservoir "a" being such that the tide will have risen one-third of its range before the water level inside has fallen an equal distance.

A third reservoir "c" must be provided to receive the water flowing through the turbines from the tidal way, during the time that the tide is rising from one-third of its range to high tide. It must then be filled to high-tide level direct from the tide, so that when the latter has fallen one-third of its range, the contents may be discharged through the turbines into the tidal way.

By an arrangement of valves and sluices all the reservoirs can be controlled automatically to perform their several functions as and when required.

The technical description of the several sluice valves or gates, of the structural details of the supply, or turbine chamber, and of the embankment walls was given in detail in the author's paper on tidal waters as a source of power, which was read and discussed before the Society of Engineers on May 5. It is, however, necessary to state that the cost of these details has been exhaustively considered, and it has been found that though the expense entailed is very heavy, it cannot be considered prohibitive unless the capacity of the installation is less than it should be to justify the outlay. For it will readily be seen that the length of the embankment walls will not increase directly as the area of the reservoirs, and hence that within defined limits, the greater the capacity of the installation the smaller will be its cost per unit of horse-power.

It is hoped that in the near future an opportunity will be found to obtain, not only a close estimate of the cost of a tidal installation, but also a proof in practice of its convenience and economy as a means of reducing the national consumption of fuel. C. A. Battiscombe.

NOTES.

The ninety-sixth annual meeting of the Société Helvétique des Sciences Naturelles is to take place this year at Frauenfeld from September 7 to 10. The programme is an interesting one. Among the lectures announced which are likely to attract considerable attention we notice that by Dr. de Quervain, of Zürich, on the Swiss Expedition to Greenland and its results, and that by Prof. Keller, of Zürich, on the geography of the fauna of the Caucasus, both of which are to be illustrated by lantern slides. Prof. Maillefer, of Lausanne, who will speak of his researches on the laws of geotropism, and Prof. Dutoit, of the same city, who will discourse on recent conquests in the realm of analytical chemistry, are equally certain of an attentive audience. Besides these, Prof. Grubemann's, of Zürich, account of the development of the modern theory of rocks, and Prof. Rikli's geographical studies in the flora of the Caucasus, as well as Prof. Fuhrmann's, of Neuchatel, sketch of his scientific researches during his journey through the Cordilleras of Columbia, will be awaited with interest. Among the men of science who have announced their intention of making communications to the separate sections are Prof. Edouard Fischer, of Bern, and Prof. Ernst, of Zürich, in the botanical section; Dr. Paul Arbenz and Dr. H. Schardt, of Zürich, in the geological section; Prof. C. E. Guye, of Geneva, and Prof. Perrier, of Lausanne, in the physical section, as well as Prof. Einstein and his colleague at Zürich, Prof. M. Grossmann, in a discussion of the physical and mathematical basis of the theory of gravitation, to take place at a common sitting of the physical with the mathematical section. In the latter section, though only added of late years, there is a relatively large number of communications inscribed, of which several are concerned with the more recent theories. In the section for geophysics Prof. P. Mercanton, of Lausanne, and in the section for chemistry, Prof. A. Pictet and Dr. G. Baume, of Geneva, are reading papers.

The third International Congress for Diseases of Occupation will take place under the presidency of Dr. F. von Haberler and Prof. A. Schattenfroh in Vienna in September, 1914. The subjects for discussion will be:—"The Physiology and Pathology of Fatigue, especially with Regard to Professional Work, Overwork, and Nightwork," "work in Hot and Damp Air," "Anthrax," "Pneumoconiosis," "Electrical Industrial Injuries," "Industrial Poisoning, especially by Anilin, Mercury, and Lead," "Industrial Injuries to Hearing," and "Independent Communications." The general secretary is Dr. Ludwig Teleky, Vienna IX., 23, Türkenstrasse.

The fourth International Congress of School Hygiene was opened at Buffalo on Tuesday last, and will continue in session until Saturday next. The president is Dr. C. W. Eliot. The work of the congress is divided amongst three sections, devoted respectively to "The Hygiene of School Buildings, Grounds, Material Equipment, and Upkeep," "The Hygiene of School Administration, Curriculum, and Schedule," and "Medical, Hygienic, and Sanitary Supervision in Schools."

The eleventh International Conference on Tuberculosis will be held in Berlin from October 22 to 25. Among the communications promised are the following:—"Clinical Forms of Koch's Bacillosis at Different Periods of Life," by Prof. Landouzy; "The Surgical Treatment of Pulmonary Tuberculosis," by Dr. Brauer; "Life Insurance," by Dr. K. Frankel; "State Insurance and Schools for Children with a Tendency to Tuberculosis," by Prof. Pannwitz.

The annual meeting of the International Association of Medical Psychology and Psychotherapy will take place at Vienna on September 19 and 20. The general secretary is Dr. L. Frank, 45, Zürichbergstrasse, Zürich.

The death is announced, from Bonn, of Robert Rieder Pasha, the well-known surgeon, at the age of fifty-one years. In 1898 he became a professor in the University of Bonn. Afterwards he became Inspector-General of Medical Schools in Turkey, and received the title of Pasha. He remodelled the system of medical training in Turkey, and was responsible for the establishment of several hospitals and similar institutions in and near Constantinople, and returned to Germany in 1906.

The death is announced, in his fifty-sixth year, of Mr. C. Leslie Reynolds, superintendent of the National Botanic Gardens at Washington. He had been connected with the gardens for nearly forty years.

The death is announced, in his seventy-third year, of Mr. W. Whitehead, president of the British Medical Association in 1902, and from 1894 to 1900 professor of clinical surgery in the Victoria University of Manchester.

The death is announced of Mr. J. R. Sheldon, a well-known agriculturist, at the age of seventy-three years. Mr. Sheldon was appointed to the chair of agriculture at the Royal Agricultural College, Cirencester, in 1877, being subsequently lecturer on dairy farming at Downton Agricultural College. He was the author of "Dairy Farming" and "Live Stock in Health and Disease."

The late Sir Jonathan Hutchinson, F.R.S., left by will the following directions regarding his museums at Selby, Haslemere, and Chenies Street, London:—"I leave the three museums at Haslemere, Selby, and 22 Chenies Street, and their contents to my trustees upon trust to dispose of the same as they in their own absolute discretion shall think best, but my desire is that, without imposing any trust upon my said trustees, they shall dispose of my said museums and their contents in accordance with my wishes expressed to them during my life."

By the will of Prof. Emil Chr. Hansen and his wife a fund bearing his name has been established. At intervals of two or three years, beginning in 1914, a gold medal bearing his effigy and accompanied by a sum of at least 2000 kroner is to be awarded on May 8 to the author of a meritorious publication on some microbiological subject, and recently published in Denmark or elsewhere. In 1914 the medal will be awarded to a worker in the field of medical microbiology. The president of the board of trustees is Prof. S. P. L. Sorensen, the Chemical Department of Carlsberg Laboratory, Copenhagen, from whom all information may be obtained.

On the closing day of the International Congress of Medicine, an address on the relationship between medicine and public health was delivered by the President of the Local Government Board, the Right Hon. John Burns, M.P. He surveyed the saving of life which has been effected by the application of sanitary measures, the decline in such diseases as enteric and typhus fevers, which are due to local insanitary conditions, and the stages in the registration of disease, which has proved so powerful an agent in its control. Finally, a tribute was paid to the nursing profession, and the interesting fact noted that Florence Nightingale, who initiated our present nursing system, received her preliminary training in a German institution, the Deaconess's Institute at Kaiserwörth, on the Rhine.

We see by *The Townsville Daily Bulletin* (Queensland) that the Australian Institute of Tropical Medicine at Townsville was officially opened on June 28 by Sir William MacGregor, the Governor of Queensland, in the presence of many men of science and medical men. In the course of an inspiring address, Sir W. MacGregor traced the evolution of the movement for the foundation of the institute, giving especial credit for work done to the Rt. Rev. Dr. Frodsham, formerly Bishop of North Queensland, and to Prof. Anderson Stuart, dean of the faculty of medicine in the University of Sydney. He then spoke of the work to be done by the institute in the following words:—"The field that lies open to this institute for investigation is vast and varied, covering as it does not only different races of men in health and disease in the tropics of Australia, in Papua, and in the Pacific Islands, but also all other creatures in the same great area, for in these times the transmission of many diseases from other beings to man is well known, typical of which is the 'Rossa Cycle' in malaria; but there are many others, such as the Guinea worm, from a small cyclops; yellow fever, flaria, and dengue, from mosquitoes; tapeworm from domestic animals, &c. Research work in this institute will, however, not be limited to animal organisms, but will also embrace the vegetable kingdom, especially in the forms of foods and poisons; and now, in view of the researches of Dr. Erwin Smith on cancer in plants, caused by the *Bacterium tumefaciens*, and of the remarkable conclusions of Johnson, that the bud rot of the cocoanut palm is caused by *B. coli*, the pathology of the vegetable kingdom will demand much greater attention than has hitherto been given to that subject. The institute will also concern itself with such elementary things as earth, air, water, and sunshine; in short, with everything that influences the physical life of man in the tropics. Researches in this institute will also embrace questions that concern industrial life in our tropics. Dr. Breinl's work on nodules has already been of such a character as to demonstrate that the institute will be of much service to our flocks and herds, and be important in our economic pursuits." He then touched upon the investigations that will be carried out with reference to the effect of climate on the white race in tropical Australia; the proper kind of houses to be erected for their use; the most suitable forms of food and clothing for them; the study of insect and bacterial life in disease; the economic work which will be undertaken, and the value of such an institution to the medical man who has to deal with diseases peculiar to the tropics.

A second report (the first was issued in 1910) on infant and child mortality, by the medical officer of the Local Government Board, Dr. Newsholme, has been issued by the Board. The task of the present report has consisted mainly in setting out the facts as to incidence of mortality, and in attempting to render conspicuous the experience of those towns or parts of towns in which an excessive sacrifice of child-life occurs. A great saving of child-life has been effected in the last few years, and a large portion of this decline has occurred in the towns now under report. It is satisfactory to find that this saving of life cannot be attributed merely to favourable climatic conditions, but to some degree at least is the result of improved sanitary and housing conditions. In the first part of this report the detailed facts as to incidence of infant and child mortality are set out. In its second part the close interrelationship between defective sanitation, poverty and intemperance, and excessive mortality is discussed. In its third part, a preliminary statement as to child welfare work is given.

It is announced in *The Times* that Mr. Peter Waite, of Adelaide, South Australia, is sending a collection of animals to the Scottish Zoological Park. The collection includes two kangaroos, four Bennett's wallabies, four rock wallabies, two emus, two ópossums, two eagles, two Tasmanian devils, two black swans, two magpie geese, and two ibises. The Adelaide Zoological Garden is sending two dingos, and Mr. S. S. Ralli, of Adelaide, two giant kingfishers. Mr. E. J. Robertson Grant, of Edinburgh, who is at present in the Argentine, has also intimated that he is getting together a collection of animals for the Zoological Park, and will bring them with him when he returns to Scotland in November next..

Hungary possesses a Governmental institution for the scientific study of ornithology, the Magyar Királyi Központ, or Königlich Ungarische Centrale, to which has recently been added an anatomical department, the staff of which publishes its researches in the periodical *Aquila*. Dr. Greschik, one of the assistants, has made a renewed study of the microscopic structure of the rectum of some sixty kinds of native birds

The histology of this class is usually treated somewhat cursorily in our text-books, mainly because of the minute size of the avine cells in comparison with those of other vertebrates. A number of good text-figures and a plate illustrate the details, most of which naturally can interest the specialist only, but there are also observations and conclusions, for instance, those concerning leucocytes and the protoplasmic rods of the cylindrical epithelial cells, which are of general physiological importance.

To *The Field* of August 23 Mr. R. I. Pocock contributes an article on the skin-glands of shrew-mice, in which it is pointed out that the gland on the flanks of the British species, which is generally supposed to emit the musky odour characteristic of these animals, is present only in the males. On the other hand, it is developed in both sexes of the Indian musk-shrew (Crocidura), as well apparently as in the Continental representative of that genus. It has been generally stated that the musky odour of all shrews is protective, but, in the members of the typical genus, if it be emitted by the gland, it must be a sexual feature, probably designed to attract the females. Before this can be definitely decided, it has to be ascertained whether the females of British shrew-mice are musky. If they are not, the numerous shrew-mice left dead by cats in gardens in autumn must probably all be males. Quite apart from the question whether the glands be its source, it seems, on the other hand, quite evident that in the Indian musk-shrew and its near relatives the musky odour is highly protective, rendering these animals obtrusive and "self-advertising."

THE current number of *The Quarterly Journal of Microscopical Science* (vol. lix., part 2) contains a very interesting article by Mr. E. S. Goodrich on metameric segmentation and homology. He discusses the well-known difficulty that organs which are undoubtedly homologous, inasmuch as they can be traced back to corresponding parts in a common ancestor, may nevertheless occur on different segments in different representatives of a group. The paired limbs of vertebrates are cited as typical illustrations of the problem. These shift backwards or forwards during the course of evolution in the most perplexing manner. Mr. Goodrich holds that, in order that they may be regarded as strictly homologous, it is not necessary that organs should be developed on corresponding segments in different types, and he accounts for their variation in position by a process of "transposition," rejecting the theories of intercalation and excalation of segments, re-division of the body and migration of the organs in question.

THE August number of *The Museums' Journal* is chiefly devoted to reports of the recent conference of the Museums' Association at Hull, including the presidential address delivered by Mr. E. Howarth. It is illustrated with a portrait of the president, and a photograph of the members of the association at Burton Constable, the seat of Major Chichester-Constable.

IN the second volume on insects in *The Cambridge Natural History* it is stated that the family Fulgoridæ "includes the so-called lantern-flies, in which the front of the head forms a huge proboscis that was formerly believed to be luminous." In the August number of *The Zoologist* Mr. H. W. Bell-Marley records the emission of light by the adult of a Natal species (*Rhinorthra guttata*), as well as by parasitic lepidopterous larvæ with which it is infested.

The Scientific American announces an alteration in the system of issue of publications by the United States Department of Agriculture. The old independent series of bulletins and circulars of the thirteen publishing bureaus, divisions, and offices of the department have been discontinued and will be superseded by a new *Journal of Research* for printing scientific and technical matter, and by a departmental series of bulletins, written in popular language for selected and general distribution. By this plan the confusion that has resulted from the multiplicity of series of publications will be avoided, and the saving of a considerable sum will annually be effected. Under the new plan the department will discontinue the general distribution of matter so scientific or technical as to be of little or no use to the lay reader. It will supply technical information only to those directly interested and capable of using scientific analyses, and of understanding the results of research work couched in scientific terms. A larger amount of information in popular form which the average reader can immediately apply to his own direct advantage will hereafter be distributed.

WE have received from Dr. J. H. Maiden a reprint of the presidential address delivered by him last year to the Royal Society of New South Wales. This address ranges over a wide and varied field, and contains much that is of general interest, including obituary notices and memoirs of Sir Joseph Hooker, Lord Lister, and Baron von Mueller. Reference is made to the forthcoming Melbourne meeting of the British Association and to other scientific matters of Australian interest, such as the Northern Territory Expedition of 1911, the exploration of Antarctica, the centenary of the Sydney Botanic Gardens, &c. After dealing with some botanical matters, such as the teaching of botany, a plea for a botanical survey and a new census of New South Wales plants, Dr. Maiden proceeds to set forth in some detail his views regarding the functions of a botanic garden, with suggestions as to work in phyto-chemistry and other practical proposals for increasing the usefulness of botanic gardens in Australia or elsewhere.

DR. W. A. CANNON, of the Carnegie Institution Desert Laboratory, Tucson, Arizona, has forwarded a reprint of an interesting paper on some features of the root systems of desert plants (*Popular Science Monthly*, vol. lxxxi). Among desert shrubs there are three main types of root system: (1) the superficial type, in which the roots extend horizontally from the plant axis, and lie near the soil surface; (2) the tap root, which goes directly down to a depth determined partly by the character of the soil, partly by the penetration of the rains and partly by the character of the root itself; (3) the generalised type of root, which not only reaches widely, but also penetrates fairly deeply.

The third, or generalised type, is characteristic of the great majority of desert plants; the prevalent idea that the roots of such plants are usually very long has no adequate foundation. The author adds interesting notes on the environment of the roots of desert plants—height of water-table in the soil, soil temperature, soil air, &c.—and indicates the problems which are being investigated at the Desert Laboratory with regard to the relation between desert plants and the soil.

The relative value of strong and weak wheats is a controversial question which has more than once engaged attention in the columns of Nature. The former type of wheat yields flour which is preferred by the professional baker in large cities for a number of reasons, and therefore commands a higher price. It has come to be considered of higher quality, and it is at present the object of wheat breeders all the world over to convert the indigenous weak wheats into stronger varieties. It is generally stated (for example, Humphries, Royal Society of Arts, 1909, 239) that the wheats which yield flour better suited for British consumption (by which the manufacturing centres and towns are implied), do not suit the native Indian requirements so well; indeed, wheat is more often consumed by the natives in the form of coarse cakes toasted by the side of an open fire than in the form of the light, well-risen loaf known to us. However, Mr. and Mrs. Howard, whose work in improving Indian wheats is receiving wide recognition (see Nature for August 7, p. 586), write to say that they do not agree with this view of the question, and they claim that the class of wheat preferred by the people of India for their own food is the same as that in greatest demand in the English markets. Mr. and Mrs. Howard realise fully (*Agric. Journal of India*, iii., p. 31) that any improvement in the quality of wheat to be of importance must satisfy both the people of India and the home millers.

The cultivation of tobacco in the Nyasaland Protectorate would appear to be full of promise, if one may judge from the report of the director of agriculture for the past year. During the period 1902–12 the total export of tobacco has increased from 60 lb. to $2\frac{1}{4}$ million lb., and the locally grown material so strongly resembles Virginian-grown tobacco that it is readily absorbed by the trade. In view of the large grants which have been made from the Treasury towards the cultivation of small quantities of inferior tobacco in Ireland, it is certainly striking that so much progress has been made in Nyasaland, even without the assistance of a tobacco expert. The claim is made that the possibilities of the Protectorate for tobacco-growing are probably greater than those of any other part of the British Empire.

A useful note on "Thunderstorm Statistics of Egypt" is contributed by Mr. E. W. Bliss to *The Cairo Scientific Journal* for June. The data are summarised from a list of all available records of storms prepared by request of the Cairo Department of Ordnance by the Meteorological Service, and refer chiefly to observations at Abbasia between 1868 and 1912. A table including both slight and severe storms, and also many cases where only lightning was observed, shows that during the above period electrical discharges were experienced on 180 days only. Cases occurred in each month except July, the majority being in October and November, and their rarity bears out a statement previously made that in Egypt thunderstorms are comparatively few in number. Storms accompanied by hail or heavy rain, or which did damage to buildings, only amounted to twenty-eight in the forty-five years, an average of rather more than one in two years. The discharges appear to occur most frequently during the evening hours.

The Canadian Department of the Naval Service, Ottawa, has issued a useful pamphlet on "The currents in the entrance to the St. Lawrence," from investigations of the tidal and current survey in the seasons of 1895, 1911, and 1912. The most modern methods were employed in the investigation; the temperature and density of the water, and complete meteorological observations were also taken. Between the Gaspé coast and Anticosti the currents present a complete contrast in their behaviour; on the one shore there is a current flowing always in the same direction. while on the other the set is weak and continually veering. One of the chief endeavours has been to reduce these currents to law, and in the case of the Gaspé current it has been largely successful. Although the veering currents are weak, and at times irregular, it has been possible to prove that the tide has a dominating influence upon them, and that their directions during flood and ebb are fairly definite as a rule. The features of both currents are discussed in considerable detail.

The July number of *Himmel und Erde* contains the address delivered by Dr. M. Laue on taking up his professorship at Zürich in December last. Naturally, it deals with the new field of research opened up by his own experiments on the reflection of Röntgen rays by crystals. From the results obtained by himself, and by others who have repeated his experiments, he concludes that the wave theory of the constitution of Röntgen rays is in much closer accord with the facts than the form of emission theory advocated by Prof. Bragg. The difficulties in the way of its general acceptance are not greater than those with which the wave theory of light has to deal, and the rejection of the wave theory in one case would necessitate its equal rejection in the other.

In a paper read before the American Institute of Electrical Engineers in March last, Mr. C. Fortescue showed how the excessive concentration of electrical stress which is to be found at certain parts of the insulation of electrical apparatus could be replaced by a uniform stress of much smaller amount. A short account of the electrostatic theories which underlie Mr. Fortescue's method is given by Prof. W. S. Franklin, of Lehigh University, in the July number of the Journal of the Franklin Institute. Prof. Franklin shows that the two propositions—an equipotential surface may be to any extent replaced by a thin metal sheet without disturbing the field, and a closed metal shell screens its inside from outside effects—form the basis for most of the devices suggested. Taking the field round a charged wire or that between two charged wires as his starting point, he builds up by simple processes the most important practical cases. His paper concludes with a warning against the frequent use of the idea of potential in cases in which the simpler one of the electric field will give all the required information.

OUR ASTRONOMICAL COLUMN.

THE ORIGIN OF SOLAR ELECTRICITY.—Among the many interesting papers concerning astrophysical matters which appear in No. 8 of the *Monthly Notices* of the Royal Astronomical Society, attention may be directed to a convincing contribution to our knowledge of the agencies originating the vast solar electrical phenomena demonstrated by the brilliant researches effected at Mount Wilson. In a paper under the above title Dr. J. A. Harker applies the results of laboratory work conducted in collaboration with Dr. G. W. C. Kaye at the National Physical Laboratory to the explanation of cosmical phenomena. This experimental work has shown that at very high temperatures the vapours in the tube resistance furnace become highly conducting, and that under the same condition most refractory substances emit electricity carried by particles many times the mass of an atom of the substance. Calculations show that the measured emissivity of carbon at about 3000° C. would be ample to account for solar currents of magnitude sufficient to give rise to the intense magnetic fields Professor Hale has shown to be probably found in sun-spots.

THE TRUE FORM OF THE EARTH AND ITS INTERNAL CONSTITUTION.—Dr. A. Veronnet contributes a discussion of these subjects to No. 13 of the *Revue Générale des Sciences*. It is now known that this "somewhat irregular round body" on which we live has a rough sort of tetrahedral shape, but mathematicians must have a more generalised form, and thus for them the geoid is an ellipsoid of rotation of which the inverse of the eccentricity is about 297. Dr. Veronnet criticises the various formulæ which have been suggested to represent the hypothetical generating curve, and has himself proposed a new one. By considering the effect of variations of density and velocity of rotation limits are determined for the above-mentioned ratio, and it is shown that if the above value, found by Helmert, is supported, then the earth rotates as one piece. The author is also led to make some interesting conclusions regarding the effect of tides and causes of earthquakes.

COSMOLOGICAL HYPOTHESES.—At the Science Congress held at Lourenço Marques, Mr. R. T. A. Innes, of the Transvaal Observatory, dealt with this subject, and added one hypothesis more which he referred to as "the explosion hypothesis." He assumes that matter will not indefinitely submit to continued reduction of volume under indefinitely increasing gravitational pressure, but that a time will come when this pressure will "break into the atomic structure of its matter and cause explosions." By such explosions the sun threw off the planets and the latter their satellites; in other stars they caused the formation of multiple systems; new stars are due to the eruptive outbursts accompanying the explosions, and when on a smaller scale and rhythmical they are responsible for the phenomena of variable stars. Mr. Innes, we may remark, has shown an inexplicable eclecticism in choosing his foundation facts; for example, he has ignored the harmonious results obtained by modern workers on the temperatures of the individual stars, but has selected a contrary opinion to the effect that solar type stars are hotter than the white stars.

MAGNETIC SURVEYS.[1]

THE introduction tells us that this is the first of a series of volumes to be published dealing with the researches of the department of terrestrial magnetism of the Carnegie Institution of Washington, founded in April, 1904. These volumes, while principally on terrestrial magnetism, will contain memoirs on allied subjects, such as atmospheric electricity. The present volume treats of all the magnetic observations made *on land* by the department from the beginning of its observational work in 1905 up to the end of 1910. These observations are directed towards the accomplishment of one of the principal objects which the department has in view, viz. the acquisition of the data necessary for a general magnetic survey of the earth.

The first fifty pages deal with the general methods of work, the selection and description of stations, and especially with the field instruments and the taking and reducing of observations. The observational instruments—magnetometers, dip circles, and dip inductors—and auxiliary apparatus are handsomely illustrated in plates 2 to 6. Much experience of field-work has accumulated of late years at Washington, and the instructions to observers merit the careful attention of all interested in survey work. Pp. 51–6 introduce us to the results of the observations, which are chronicled in the later part of the volume. On p. 53 is a list of thirty-five observers whose work is included. Amongst them are several eminent foreigners, including Prof. Palazzo, of Rome, and Profs. Beattie and Morrison, of South Africa, who have observed for a time under the auspices of the Carnegie Institution. The stations observed at number almost 1300, of which more than 1200 are outside the bounds of the United States.

Of the continents, Africa shows the largest number of stations, 386, the great majority of which were occupied in 1907 and 1908 by Profs. Beattie and Morrison. Of the 328 stations in North America, 189 were in Canada or Newfoundland, fifty-nine in Central America, and nine in Greenland. In Asia there were 308 stations. Of these 142 were in China—occupied mainly by Messrs. Edmunds and Sowers—thirty-seven in Persia, thirty-two in Russian and eighty-one in Turkish territory. The observations in Asiatic Turkey were due mainly to Mr. Sligh, but partly to Mr. J. C. Pearson. The latter gentleman seems to have taken all the observations in Persia and in Asiatic and European Russia, and most of those in Egypt. He also observed in Canada, in European Turkey, at Pola, Potsdam, and Kew Observatories, and was amongst the crew of the surveying ship *Galilee*, who observed in Japan, Australia, and New Zealand. His experiences as a traveller should be of interest. Of the remaining stations, 111 were in South America, and 119 in numerous islands in the Pacific and Atlantic Oceans.

The tables of results, pp. 58–100, give for each station the geographical coordinates, the date and hours of observation, the observed values of magnetic declination, inclination, and horizontal force, the instruments used, and the observer's initials. Pp. 101–120 contain interesting extracts from the reports made by the several observers. The rest of the volume is occupied by minute descriptions of the stations, to facilitate their identification. An artistically attractive feature is the reproduction in plates 1 and 7–10 of a number of fine photographs, showing a selection of the stations occupied or scenes in their neighbourhood.

[1] "Researches of the Department of Terrestrial Magnetism. Land Magnetic Observations 1905–10." By L. A. Bauer, Director of the Department. Pp. 185+10 plates. (Washington, D.C.: Published by the Carnegie Institution of Washington, 1912.)

The work is a striking example of what can be done when scientific zeal and business capacity have behind them resources such as those of the Carnegie Institution. Dr. Bauer and the staff of the department of terrestrial magnetism—both those who took the observations and those who did the necessary office work—are to be congratulated on the progress made towards the achievement of one of their principal objects of ambition, a general magnetic survey of the globe.

C. CHREE.

ADVANCE IN ECONOMIC ENTOMOLOGY.

A NOTABLE feature of recent biological research is the attention paid by medical experts to the study of insects. Capt. F. W. Cragg, of the Indian Service, has lately published two Scientific Memoirs (Nos. 54 and 55) of the Medical and Sanitary Departments of the Government of India, which are of importance to students of the anatomy of Diptera. Both memoirs deal with blood-sucking species, No. 54 with *Philaematomyia insignis*, and No. 55 with *Haematopota pluvialis*. The excessively small number of males of the latter fly is believed by Capt. Cragg, after examination of the genitalia of the female insect, to be explained by heavy mortality as the result of pairing. We notice that the bibliography of this paper contains some remarkable misprints, of which "Verh. yool-bat. Gas. Wein" is worthy of record as a piece of unconscious humour! The last published part of the Bulletin of Entomological Research (vol. iii., part 4, December, 1912) contains valuable systematic papers on blood-sucking Diptera, by Mr. E. E. Austen and Prof. R. Newstead, and some very useful diagnoses of the larval stages of African mosquitoes, by Messrs. F. W. Edwards and A. T. Stanton.

The same number of the bulletin is noteworthy for a suggestive paper by Dr. J. Dewitz on the bearing of physiology on economic entomology. The author points out, for example, the importance of a precise knowledge of the effect of stimuli due to light of varying intensity and wave-length if luminous traps for destructive moths are to be used to the best advantage. Temperature is also found to be a factor in the working of this reaction; "the colder the night the fewer the females (and in particular females with eggs) that are caught by acetylene trap-lamps."

In a lately issued bulletin (Entomology, No. 113) of the U.S. Department of Agriculture, Messrs. W. D. Hunter, F. C. Pratt, and J. D. Mitchell describe the principal cactus insects of the United States. The "prickly pears" (Opuntia) are well known as furnishing food and habitation for the cochineal insect; since the decline of the cochineal industry, however, these plants were regarded rather as noxious weeds until the recent recognition of the fact that they furnish valuable fodder for cattle. Insects which injure them are therefore regarded as economically important, and in this short memoir a number of species of various orders are described and figured.

Some very important observations are contained in a small bulletin (No. 203) issued by the Maine Agricultural Experiment Station in 1912. Miss Edith M. Patch has apparently shown that the aphid causing "leaf-curl" on the elm (*Schizoneura americana*) migrates in spring to the apple and other Rosaceæ, and becomes the parent of the aërial colonies of the notorious woolly aphid, *S. lanigera*. The elm is thus the normal host of the sexual forms in autumn, and the apple is to be regarded as an "intermediate" host. The extreme rarity of sexual forms of *S. lanigera* on apple in these countries may perhaps be explained by a similar unsuspected migration here, though our native elm "leaf-curl" aphid (*Schizoneura ulmi*) is generally regarded as distinct from *S. americana*, and identical with the polyphagous root-feeding form, *S. fodiens*.

The gipsy moth (*Porthetria dispar*) and the brown-tail moth (*Euproctis chryssorhoea*) are well-known examples of European insects which, having been introduced into America, have become there very serious pests. From among the voluminous writings of forest entomologists on these species, one or two recent papers are worthy of especial notice. A. F. Burgess gives an account (U.S. Dept. Agric., Entom. Bull. 119, 1913) of the means by which the gipsy moth extends its range. On account of the excessive weight of the female's body, she is unable to fly, though provided with wings, and the spread of the insect from place to place is carried on mostly during the larval stage. The caterpillars are often artificially though unwittingly transported by farm carts, and it appears that one generally unrecognised evil result of automobile traffic is that these destructive insects are carried far more widely and rapidly than formerly by the passage of motors along main roads which are bordered by infested woods. The young larvæ, however, are provided with a natural means of dispersal in form of long hairs, which enable them to be carried by wind for considerable distances. Some ingenious experiments on this subject have been made by erecting tall platforms provided with traps in which the little caterpillars are caught on their aërial journeys.

As these destructive insects were introduced from Europe, the American entomologists have naturally tried the experiment of importing some of their natural enemies, and an exhaustive report on this subject has been published by Dr. L. O. Howard and W. F. Fiske (U.S. Dept. Agric., Entom. Bull. 91, 1912). To summarise the mass of material in this bulletin is impossible, but the magnitude of the work undertaken may be judged from such a fact as that 11,000 egg-clusters of the brown-tail moth were imported from Europe in the autumn of 1906, and 40,000 specimens of a single species of hymenopterous egg-parasite, *Pteromalus egregius*, reared from these were turned out in New England woodlands during the succeeding spring. Many valuable bionomic details with regard to the parasites are recorded, and reference is made to attempts—successful or otherwise—to introduce predaceous enemies of other harmful insects into countries where the latter have themselves obtained a foothold. A short special paper on a cognate subject is R. S. Woglum's report on a trip to India and the Orient in search of the natural enemies of the Citrus white-fly (*Aleyrodes citri*); this forms Bull. 120 of the Entomological Bureau of the U.S. Dept. Agric.

A much-needed systematic monograph of the "white-flies," or "snowy-flies" (Aleyrodidæ) is commenced by A. L. Quaintance and A. C. Baker in the Technical Series, No. 27, of the same bureau. These insects are allied to the Coccidæ and Aphididæ, but have received far less attention from entomologists than those two families. In the work now begun their structure, classification, and bionomics are dealt with as fully as possible in the present state of knowledge; ultimately the authors think that the family may prove as rich in species as the Coccidæ or Aphids.

Another valuable systematic paper of economic interest is Prof. M. Bezzi's memoir on Indian Trypaneids, or fruit-flies (Memoirs Indian Museum, vol. iii., No. 3, 1913). These are small Diptera included in what used to be known as the "acalypterate" series of the Muscidæ. The careful, systematic study of such insects is of importance, and Dr. Annandale, the director of the Indian Museum, is to be congratulated on having obtained the help of such an eminent European student as Prof. Bezzi, of Turin.

The Imperial Bureau of Entomology begins this year to supplement the Bulletin of Entomological Research by a *Review of Applied Entomology*, issued in two series—A, Agricultural, and B, Medical and Veterinary. Containing records of recent literature, with full summaries, these publications cannot fail to be valuable to students of insect life.

G. H. C.

METEOROLOGICAL REPORTS.

We have received the meteorological observations made at the Hamburg Astronomical Observatory for 1910–12. This institution was established in the town of Hamburg in 1825, and was for many years under the able superintendence of Dr. Rümker; it is now situated at Bergedorf, 19 km. E.S.E. of its former position, and is under the superintendence of Dr. Schorr. Very complete and careful observations are made five times daily; the amount of cloud is also given for each hour between 6h. p.m. and 6h. a.m. The sunshine is recorded by Campbell-Stokes (burning) and Jordan (photographic) instruments. The average annual difference in the possible percentage for 1910–12 is 6·7 in favour of the Jordan recorder. Although the observations are not strictly comparable, we should not have expected so much difference. An interesting comparison of temperature and humidity in English and French screens is made with the readings of an Assmann's aspiration psychrometer. The hourly means of temperature in both screens are generally higher than those of the psychrometer; the greatest differences occur in daytime, especially in the French screen (open at bottom), but at the 9h. p.m. observation the reverse obtains. Humidity in the screens is generally higher than the readings of the psychrometer, especially during summer.

The report of the Sonnblick Society for the year 1912 contains the results of the meteorological observations on the summit of the Sonnblick, Salzburg (3105 metres), for twenty-five years, 1887–1911, prepared by Hofrat Dr. J. v. Hann. The mean monthly temperatures were:—January, $-13·3°$ C. (February, $-14·0°$); July, $0·9°$; year, $-6·6°$; mean of absolute extremes, $9·5°-29·7°$. Mean yearly precipitation, 1715 mm., on 216·7 days. Fog was observed on 251·5 days. The mean yearly sunshine was 1496·9 hours, being 35 per cent. of the possible amount. The duration of sunshine varies greatly in different years; September, 1895, had 241 hours, August, 1896, only eighteen hours! November and January have relatively the most sunshine, May and June the least. Winter and late autumn are the brightest seasons, April to June the dullest months. Among other useful summaries contained in the report we may mention the observations at the summit of the Donnersberg, Bohemia (835 metres), for the years 1905–9. The observatory is attached to the German University at Prague, under the direction of Prof. R. Spitaler.

The report and meteorological observations at the Royal Observatory, Hong Kong, for the year 1912 have reached us; the results have been carefully prepared by Mr. T. F. Claxton, formerly director of the Mauritius Observatory. The tables include hourly values of the principal elements, five-day means, and results of magnetic observations. The mean annual air-temperature, 71·9°, was about normal; maximum, 92·5°, in September; minimum, 45·3°, in December. The rainfall, 63·9 in., was about 20·5 in. below the average. The colony was not actually visited by a typhoon, but the tracks of those and of the more important depressions which occurred in the Far East during the year are shown on two plates. A weather map and reports from about forty stations are issued daily; the forecasts drawn from these data for various districts show a very high percentage of success. A large amount of data is extracted from ships' logs; this is utilised in determining typhoon tracks, and to some extent for the eventual publication of pilot charts of the Pacific for the area 9° S. to 45° N. latitude, and 100° to 180° E. longitude, divided into two-degree squares.

HORTICULTURAL INVESTIGATIONS AT THE WOBURN EXPERIMENTAL FRUIT FARM.[1]

In a flower, such as that of an apple-tree, there is a tubular structure in the centre, forming the female portion of the flower, and that is surrounded and overtopped by a number of rods, bearing at their extremities sacs of pollen, this constituting the male element. When a grain of pollen, either of the same or another flower, enters the central tube, or pistil, fertilisation occurs, and a seed, or pip, begins to form near the base of the pistil. As it develops, the woody substance surrounding it, which is really a portion of the stalk of the tree, gradually swells to a remarkable extent, and eventually forms the fleshy or edible portion of the fruit. We commonly call it the fruit, but it is only a metamorphosed portion of the mother-tree: the real fruit of the tree, the progeny of male and female elements, is the pip. When this is sown in the ground, it germinates, and eventually forms a new tree, which, though probably showing some resemblance to its two parents, will be a new variety, and will not bear apples of the same sort as the mother-tree. One reason which makes it all the more improbable that a pip will give rise to a tree bearing fruit like that of the mother-tree, is that in many cases the female portion of the flower cannot be fertilised except by pollen from a tree of a different variety.

As it is impossible to reproduce a fruit-tree of any given variety from seed, other methods of multiplication must be adopted, namely budding or grafting. A young tree of a similar character is taken (the stock), and in the one case a bud, or in the other case a twig (scion), from the tree to be propagated is united with the stem of the stock. All the growth arising from this bud, or buds, is similar to that of the tree from which it was taken; the stock acts as little else than a channel for conveying nourishment to the ingrafted buds; yet it does exert a certain influence on the character of the growth of scion. For apples we use two classes of stocks; the one, the crab stock, is obtained by sowing the seeds of crab-apples, and is characterised by forming a scanty number of roots, but these are stout, and have a tendency to obtain deep hold of the ground; the other, the paradise stock, is derived from a French variety of apple, and forms a much larger number of roots, but smaller, and tending to spread out near the surface of the ground. The grafted tree partakes of the character of the roots of the stock; on the paradise stock it becomes more spreading in its habit, and grows less vigorously than on the crab stock, and, whilst the former is more suitable for growing trees in the bush form, the crab stock is more suited for standard trees.

In the case of pears, the corresponding stocks are: the pear stock for standard trees, and the quince stock for bush trees.

It must be remembered, however, that the effect of the stock on the growth of a tree is a subsidiary

[1] From a discourse delivered at the Royal Institution on Friday, February 21, by Mr. Spencer U. Pickering, F.R.S.

matter; the characteristics of the growth are mainly dependent on the nature of the scion.

During removal of a tree from the nursery to the plantation many of the roots are destroyed, and nearly all of them are injured. The seat of growth of a root is situated at the extreme tip of the root, the power of multiplication being confined to a few meristematic cells which are centred there, these being protected only by some layers of outer cells, known as the root-cap, which are continually being rubbed off and reproduced from the meristematic cells, as the root forces its way through the earth. The whole root-tip is very minute, and when it is destroyed, growth becomes impossible; but there are certain cells situated at intervals along the roots which are capable of becoming modified and giving rise to new root-tips, just as there are cells in the branches capable of developing into buds if all the visible buds of a tree are destroyed.

When a tree is removed from the soil, most of the root-tips will inevitably be broken off, and the rest will become dried up by exposure to the air, so that the damage to the roots must be serious. But the well-being of a tree depends on the balance between roots and branches, both of which supply certain, but different, elements necessary for growth, and this serious damage to the roots can only be counterbalanced by damaging the branches to a corresponding extent. This is done by severely pruning the branches, cutting them back, as it is termed, to about one-third of their length. The effect of omitting this operation is often disastrous; the tree may become permanently stunted, and even, in the case of plums, which tend to bear heavily after moving, it may be fatal.

Though good horticulturists agree as to the necessity of cutting back after transplanting, they differ as to the time when this should be done. The results of our experiments on a large number of trees show that the time of cutting back makes little difference to the ultimate size of the tree, so long as it is not performed while the tree is in active growth. If it is done in the summer, however, the tree receives a serious check, from which it does not recover for at least the next seven years. Deferring the cutting back until the following winter does not give the tree any such check as regards its growth, but it affects its fruiting. Such deferred cutting back is generally followed in the second year by vigorous growth, the tree making up for the absence of growth during the first year, and it perseveres in this habit of growing in subsequent years, when it ought to be growing and fruiting as well.

Passing on to the question of the annual pruning of a tree; it is a common belief that the more you prune a tree the more it will grow. It seems fairly obvious that, even if true at all, this must be true only within certain limits; and, as applied to young, freely growing trees, it appears to be quite untrue. Various plantations of similar trees at Woburn have been systematically pruned to different extents during the seventeen years since they were first planted, and the photographs of average specimens from these plantations are sufficient to show that, as regards the general size, the trees which have never been pruned are larger than those which have been pruned moderately, and these again are larger than those which have been pruned hard. What may be noticed as to the latter is that it is a sturdier tree than that pruned moderately, the trunk and main branches having gone on swelling, while the extension of the branches was prevented by the severe pruning. On the other hand, the unpruned tree, as might naturally be expected, is somewhat straggly and not well shaped.

Another experiment will illustrate the extent to which pruning is opposed to growth. Four strictly similar twigs, 36 in. long, were selected on the same tree: one was not cut back, the others were shortened to 24, 12, and 6 in., respectively. At the end of the following season the weight of these twigs (taking the average of many series) was in the proportion of 562 : 310 : 178 : 100, and from every point of view the growth of the twigs had been greater in proportion as they had been less pruned (Fig. 1). In addition to this, it was found that there were more fruit-buds, and, therefore, a greater promise of fruit, the less the twigs were pruned; the relative proportions of fruit-buds in these cases were 314 : 238 : 165 : 100. That this promise is actually fulfilled in practice is proved by the records of the crops borne by plantations of similar trees which have for many years been pruned to different extents. In one case these plantations contained three different varieties of apples; it was found that during the first five years, and also during the second five years, the unpruned trees bore twice as much, and the hard-pruned ones little more than half as much, as the trees which had been pruned moderately. These trees were on the paradise stock; but the same was found to be the case with apples on the crab stock, for we have another plantation where 117 different varieties of apples are grown, four trees on the one stock, and four on the other; in each case one-half of them have been pruned lightly, and one-half heavily, and in both cases the crops from the latter have been less than one-half of those from the former.

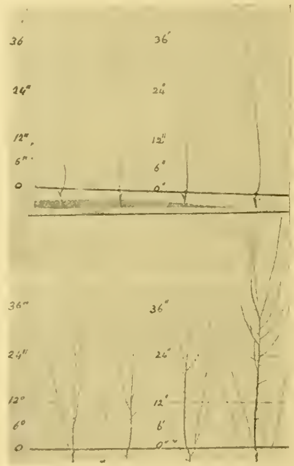


Fig. 1.—Four similar shoots cut back to different extents, showing the different growth made by them.

What has surprised us is that the heavier crops in these cases have not been accompanied by any serious diminution in the size of the individual fruits.

It is thus established as a fundamental principle, that the less pruning there is, the more will a tree grow, and the more fruit will it bear. But this does not mean that we should dispense with pruning altogether. The chief object in training a young tree is to make it sturdy and well-shaped, so that it will be capable of bearing a heavy crop when it comes to full maturity; to effect this, the extension of the branches must be checked so as to give the stem and main branches time to fill out, and occasionally a branch will have to be removed altogether, either to admit light and air into the tree, or to prevent it rubbing against other branches. To what extent this pruning should be carried, and for how long it should be continued, must depend on the habit of the tree. Instances of injury through the absence of pruning may be seen in nearly any farm orchard throughout the country; but examples of over-pruning are almost as general, and are to be found in most private gardens, where the stunted trees throw out every year thickets of twigs, serving no other purpose than that of feeding the bonfire.

Besides the annual branch-pruning there are other operations included under the term pruning, but the only one to which I can now allude is root-pruning. In this the roots are unearthed and cut back, with the view of increasing the fruitfulness of the tree. The check which such an operation gives to the growth is very severe, and if carried to excess, will kill the tree entirely. It is evidently one which should be undertaken only in very exceptional circumstances, such as where the tree is showing rampant growth, and will neither flower nor fruit. We hear little of root-pruning except in private gardens, and we should scarcely ever hear anything of it there if a more rational system of branch-pruning were adopted. When the branches are cut away to an excessive extent, the balance between branch and root can only be restored by cutting the roots away too. But to injure the tree in one way, and to attempt to correct matters by injuring it in another way, is not a very intelligent procedure.

Passing to the problems connected with the transplanting of a tree; during this operation many of the old root-tips are torn off in lifting the tree, but others are killed by becoming dried up on exposure to the air. Some exposure is always inevitable, and in most cases several days elapse between the lifting and the planting of a tree. It is of great importance, however, that this exposure should be reduced to the narrowest limits. A number of trees were lifted at Woburn, and some of them were replanted at once, whilst others were left in a shed for four days before doing so, and it was found that the latter made only four-fifths as much growth as the former during the following season. It is on this account that planting trees in the spring should be discountenanced, as drying winds are then more prevalent; but if this drying effect is avoided, it is immaterial when the planting is carried out: similar trees planted at different times between November 28 and March 3 were found to do equally well.

Much stress is always laid by horticulturists on the importance of selecting trees with a good supply of fibrous roots, and of taking the utmost care of these roots, spreading them out, and shaking the earth lightly between them. But such precepts are based on ignorance as to the principles of root-growth. Nine-tenths of these roots have lost their tips, they are useless, and as good as dead, for they certainly will die in a very short time. Anyone can satisfy himself on this point; it is only necessary to mark a few of these roots by tying strands of silk round them, and on lifting the tree again at the end of the season it will be found that the rootlets have all, or nearly all, died, and that in their place a new system of rootlets has arisen from the thicker portions of the older roots. In fact, we have found that trees do better if the smallest of the fibrous roots are removed before planting, and also if all the roots are shortened to a certain extent. The reason of this is, not only that it is well to remove parts of the tree which are bound to die, but that the new rootlets which form will be more vigorous if they originate from the thicker portions of the old roots, where the store of material for their nourishment is greater. The practice of leaving the roots as long as possible, and carefully trimming their ends, is quite a mistaken one, for the ends of these roots, having lost the root-tip, cannot start into growth again, and it has been found that of the new rootlets which originate, only some 15 per cent. arise from the neighbourhood of the ends of the old roots, the rest originating from higher up towards the stem, or even from the stem itself.

Two other conclusions may also be drawn from what has been mentioned, namely that it can make little or no difference to the future welfare of the tree whether the ends of the old roots are trimmed, or left jagged and torn as they are when removed from the nursery, nor whether these roots are carefully spread out in the ground, instead of being huddled into the hole prepared for them; for it is the new rootlets which are to be formed, and not the old ones, on which the future life of the tree depends. Both these conclusions have been verified by actual experiment. Even when the roots were twisted and tied together in a bundle, the tree did just as well as when they were spread out in the orthodox fashion.

It is thus seen that all these practices which are supposed to be essential to the proper planting of a tree are really immaterial, and, in fact, that the violation of them within certain limits is beneficial. But the benefit was not sufficient to explain certain results which we obtained, and which puzzled us for many years. We had made a plantation in which, by way of demonstration, the trees had been planted in violation of all the accepted canons, and we expected that these trees would afford an awful lesson to the careless planter. But instead of that, they flourished rather better than their carefully planted neighbours. The results were naturally set aside as accidental, and a repetition, and subsequently many repetitions, were made; but the roughly planted trees refused to behave badly, and flourished so much more than their neighbours that they often showed two or three times more growth than these did. The principal cause of this was eventually traced to the fact that the soil round these trees had been heavily rammed at the planting, instead of being shaken over the roots and merely pressed down. When we consider that the welfare of the transplanted tree depends on its sending out new rootlets from the old roots, it is evident that anything which brings the soil into intimate contact with these roots will be beneficial, and ramming the soil down, especially if it is in a wet condition at the time, will do this more effectually than could ever be done by the gentler method of planting. These somewhat surprising results, therefore, receive a simple explanation, and it is easy to satisfy ourselves, by lifting the trees at the end of a year, that the rammed trees have actually formed more new roots than those carefully planted. Such novel methods of planting naturally excited the wrath of horticulturists, who, as a body, are inclined to carry the veneration for traditional procedure to excess, and we were careful to obtain overwhelming evidence as to the facts before publishing our results. Some seventy sets of experiments were made, in which about 2000 trees were used; the soils in which the trees were planted being of every variety, and situated in eight different counties. Naturally, the results varied, but the average of them showed that ramming might be expected to increase the growth of the tree by nearly 50 per cent., during the first or first two years, at any rate in heavy or fairly heavy soils. In a light sandy soil it naturally had no effect, for the obvious reason that, by the time the tree started into growth, any consolidation of the soil caused by the ramming would have disappeared. In one case only were the results of ramming very bad, and that was in the London clay, where the absence of aëration caused sulphuretted hydrogen to be developed. In other clay soils, no such results ensued (the Woburn farm itself is on the Oxford clay).

That trees will not flourish unless the soil in which they are growing is sufficiently aërated, is well known.

And this is the reason why a tree, when planted, should not be buried deeply in the soil; but a latitude of a good many inches in the depth at which it is planted has been found to make no difference, because the new roots, on which the life of the tree depends, form most readily at whatever depth is most suited to their development, or if they form at other depths, they soon make their way to the most favourable level.

The fact that roots flourish best at some particular level not far below the surface (the depth varying in different soils) is the explanation of some results which appeared to show the exact contrary. A number of paradise stocks were planted with their roots at various depths from 6 to 24 in. below the surface, and it was found that those which had been buried deepest, although they were the most backward at first, rapidly outstripped the others, and in two years had made twice as much growth as these had done. On lifting the trees the reason of this was apparent; in the case of those which had been planted at the ordinary depth, the root-system of the trees was the same as that which they had possessed when planted, though more developed (Fig. 2), whereas, with the buried trees, the original roots, finding themselves at an unsuitable depth, had not developed, but in their place numerous fresh roots had developed from the stem of the tree itself (Fig. 3), and these, finding ample food-material stored in the stem, had developed strongly, and formed a vigorous root-system, with the natural accompaniment of vigorous branch growth. Such results, depending as they do on the ability of the tree to send out new roots from its stem, would not be obtained if a grafted tree were buried in the same way, for roots do not easily arise from the stem of such a tree; indeed, when the experiment was made with crab-stocks instead of paradise-stocks, the results were unfavourable, for the crab-stock does not root so easily from the stem as does the paradise-stock. Thus, these experiments are the reverse of showing that an ordinary fruit-tree should be planted at a great depth.

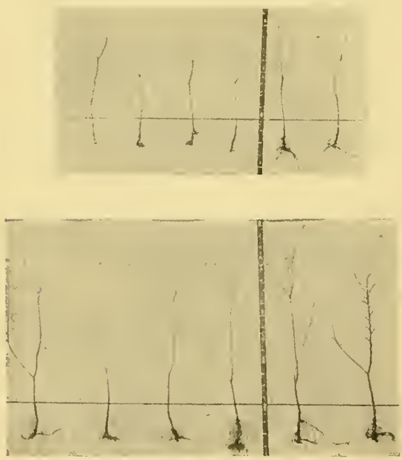


FIG. 2.—Apple stocks planted 6 inches below the surface, and lifted two years afterwards.

It will be seen that all the anomalous results which have been obtained on the subject of planting are easily explained by, and are the natural consequences of, the fact that a tree when transplanted has to form a new root-system before it can begin to grow again, and if this is but kept in view, the whole subject becomes simplified, and the reason becomes evident why many of the practices supposed to be essential to the proper planting of a tree do not bear the test of actual experiment.

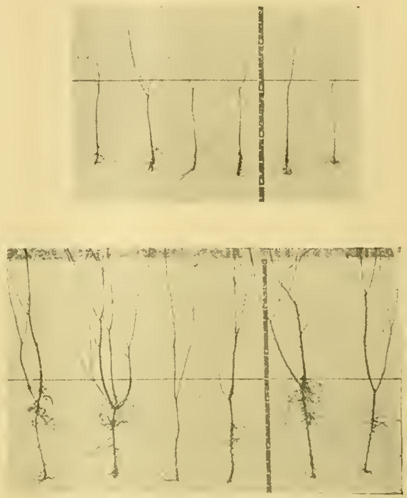


FIG. 3.—Apple stocks planted 24 inches below the surface, and lifted two years afterwards.

EXPLORATIONS AND FIELD-WORK OF THE SMITHSONIAN INSTITUTION IN 1912.

FOLLOWING the custom established in 1911, the Smithsonian Institution has issued an illustrated pamphlet dealing with the scientific expeditions conducted under its direction, or in which its representatives participated. The pamphlet describes the work of about twenty different parties.

The institution was represented by two small parties in Borneo—those of Mr. H. C. Raven, who has been collecting mammals and ethnological material in Dutch East Borneo for the past two years, and Mr. Daniel D. Streeter, of Brooklyn, N.Y., who has served as a collaborator for the National Museum in the collecting of mammals, in a trip through Sarawak and Dutch Borneo.

Dr. W. L. Abbott, who financed the Dutch East Borneo Expedition under Mr. Raven, and has presented many large collections to the National Museum, has been carrying on a personal investigation in Cashmere, where he has been trapping and studying the smaller mammals of that country, specimens of which have been sent to the museum.

Through the invitation of Dr. Theodore Lyman, of Harvard University, the institution was enabled to cooperate with the Museum of Comparative Zoology in an expedition to the Altai Mountains of Siberia and Mongolia. Mr. N. Hollister represented the National

Museum. The party spent nearly five months in the field, returning with fine series of mammals and birds from this little-known part of Central Asia. Of especial interest in the series of big-game are four rams of the largest known of the wild sheep, as well as specimens of two forms of ibex, and a gazelle. Out of a total of about 650 mammals in the collection, eleven forms are new to science, and some twenty were not previously represented in the National Museum. Mr. George Mixter also visited Siberia, where he secured certain mammals from the region about Lake Baikal, among them bear and seal.

Of particular interest was a trip made by Dr. Ales Hrdlička to Siberia and Mongolia, to study the physical anthropology of the natives. His main object was a search for data concerning the race which is supposed to have peopled America. He gathered extensive information and collections, from which he draws the conclusion that there exist in several places in Siberia, Mongolia, and Tibet numerous remains of an ancient population which was physically identical with, and in all probability gave rise to, the American Indian.

The hunting trip carried on by Mr. Paul J. Rainey in British East Africa, in which the institution was represented by Mr. Edmund Heller, was very successful; nearly 4000 mammals, 1000 reptiles, and 400 birds were obtained, as well as many land shells and botanical specimens. From the collection, which supplements that of the Smithsonian African Expedition, there have been as many as forty new species and twelve new genera described.

The Astrophysical Observatory of the Smithsonian Institution again sent an expedition to Bassour, Algeria, for the continuation of the observations relative to the heat of the sun, an investigation on which the observatory has been working for the past seven years, with observing stations on Mt. Wilson, California, and during two seasons in Algeria. Mr. Abbot, the director of the observatory, states that the results of the work of 1911 and 1912 thoroughly establish the supposed variability of the sun.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The scheme for the administration of the East London College, a school of the University of London in the faculties of arts, science, and engineering, was sealed by the Board of Education on August 15. It establishes a governing body of nineteen members, nine of whom are representatives of the Drapers' Company, the body from which the college derives rather more than half its annual income; three representatives of the University, one of whom must be a woman, with the principal of the college *ex officio*, two of the Academic Board, which consists of the principal members of the teaching staff, one of the London County Council, and three coopted members. The representatives of the University are Lady Busk, Principal Sir Henry Miers, F.R.S., and Mr. F. D. Acland, M.P., Under-Secretary for Foreign Affairs, who is a member of the Senate of the University.

MR. HAROLD PEALING, Liverpool, has been appointed lecturer in physics in the South African College, Cape Town.

PROF. W. H. YOUNG, F.R.S., has been appointed Hardinge professor of mathematics in the University of Calcutta, for the purpose of organising a new school of higher mathematical thought and research. Prof. Young is retaining his chair in Liverpool University.

WE learn from the Allahabad *Pioneer Mail* that at a meeting of the Bombay University Senate on July 26 Sir Alfred Hopkinson, K.C., until recently Vice-Chancellor of the Victoria University of Manchester, was appointed expert adviser on university teaching to the University for a period of six months.

THE calendar for the session 1913–14 of the Merchant Venturers' Technical College, Bristol, is now available. It will be remembered that the faculty of engineering of the University of Bristol is provided and maintained by this college, which, in addition, includes a secondary school for boys and a comprehensive series of evening classes in science, technology, and commercial and other subjects. The evening courses of work in technology have been arranged to meet the special needs of engineers, men engaged in the building trades in general, carpenters and joiners, plumbers, and painters and decorators. Saturday afternoon classes for miners have been arranged by the Gloucestershire and Bristol Education Committees and are given in the college. In addition special courses of instruction for women in domestic subjects are provided.

THE Education Committee of the Staffordshire County Council has published its "Directory for Higher Education, 1913–14." The booklet contains the regulations of the committee and details of schemes of work in operation throughout the county. Instruction in mining is provided by means of lecturers, whose whole time is devoted to the work, and their assistants. For this purpose the county is divided into two portions, comprising the North Staffordshire coalfields and the South Staffordshire coalfields respectively. Classes in metallurgy and iron and steel manufacture are conducted in accordance with the regulations of the Board of Education and the City and Guilds of London Institute. Classes in pottery and porcelain manufacture have been arranged at Burslem, Hanley, Longton, Stoke, and Tunstall. Boot and shoe manufacture, silk manufacture, horticultural and smaller agricultural industries are each to be taught in suitable centres. The directory also gives particulars of the numerous scholarships awarded by the committee, the holiday courses arranged, and the steps taken to provide suitable technological instruction in the rural districts.

PARTICULARS have been issued by the Royal Horticultural Society with reference to the examinations for the national diploma in horticulture, which, so far as possible, will be held in the latter part of June of each year. The scheme, which has been approved by the Board of Agriculture and Fisheries, sets forth that candidates for the diploma must (*a*) register themselves with the society, and (*b*) pass two examinations, a preliminary and a final. The examinations are open to both men and women. The preliminary examination will be based upon the general principles of plant-growing, an elementary knowledge of botany, chemistry, and physics, so far as acquaintance with these subjects is essential to an understanding of garden practice. Care will be taken to ascertain that the candidate is able to perform the operation of gardening with proper skill, and also that he understands the reasons for the methods employed. The syllabus for the final examination will be divided into sections each dealing with one particular branch of horticulture. Candidates may enter for the branch in which they feel themselves most proficient. All particulars, forms, &c., may be obtained from the secretary of the Royal Horticultural Society, Vincent Square, S.W.

THE calendar of the Royal Technical College, Glasgow, for the coming session contains details of the scheme affiliating the college to the University of

Glasgow. The college retains its autonomy in all matters relating to its internal affairs—finance, appointment of staff, and so on—but it has no representation in the Court of the University. An advisory committee has been set up, consisting of members of the University Court and representatives of the college, which will consider all matters affecting their joint interests. A joint board of studies in the faculty of applied science is provided, and will consider all matters relating to the subjects and standard of the several courses. The degree examinations will be conducted by a board of examiners representative of both institutions, with external examiners appointed by the University Court. Students will be free to attend the classes constituting the courses of study in either the University or the college, or in both, the fees being the same. The combination and coordination of the resources of the University with those of the college should be to the advantage of both. The University of Edinburgh, too, has recognised the day classes of the college as qualifying for its degree of bachelor of science under certain regulations.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 18.—M. A. Chauveau in the chair.—M. **Borrelly**: Notes on Hind's nebula. This nebula is now at a maximum period of brightness.—M. **Aries**: The formula for the velocity of sound. Reply to M. Duhem.—MM. **Massol** and **Faucon**: The presence of absorption bands in the ultra-violet spectrum of some abnormal alcohols of the fatty series. The study of pentane and some derivatives of methylpropane and methylbutane shows that the two absorption bands previously found in the three primary alcohols do not appear in the corresponding hydrocarbons; the halogen derivatives are also free from bands. The aldehydes give one large absorption band intermediate in position between the two alcohol bands.—Paul **Godin**: Free thoracic and abdominal respiration in the course of growth.—De Montessus de **Ballore**: Remarks on the earthquake at Gallipoli, August 9, 1912.

BOOKS RECEIVED.

A History of British Mammals. By G. E. H. Barrett-Hamilton. Part xiv. Pp. 361–408+plates. (London: Gurney and Jackson.) 2*s*. 6*d*. net.

Handbuch der Vergleichenden Physiologie. By Hans Winterstein. Lief. 36. Zweite Hälfte. (Jena: Gustav Fischer.) 5 marks.

Swiat I Cztowick. By Dr. J. Mianowskiego. Pp. 355. (Warsaw.) 2 rub.

A Treatise on Quantitative Inorganic Analysis. By Dr. J. W. Mellor. Being vol. i. of a Treatise on the Ceramic Industries. Pp. xxxi+778. (London: C. Griffin and Co., Ltd.) 30*s*. net.

The Application of Physico-Chemical Theory to Technical Processes and Manufacturing Methods. By Prof. R. Kremann. Translated from the German by H. E. Potts, and edited by Dr. A. Mond. Pp. xv+212. (London: Constable and Co., Ltd.) 8*s*. 6*d*. net.

Botany. By Prof. E. Brucker. Pp. xv+185. (Thresholds of Science Series.) (London: Constable and Co., Ltd.) 2*s*. net.

Ministere de l'Agriculture. Direction Générale des Eaux et Forêts. Service des Grandes Forces Hydrauliques. (Région du Sud-Ouest.) I., Comptes rendus des Opérations Effectuees. II., Résultats Obtenus pour le bassin de l'Adour au 31 Décembre, 1910. Tome i. Pp. 262+plates. Résultats Obtenus pour le bassin de la Garonne au 31 Décembre, 1910. Tome ii. Pp. 515+plates. 2° Partie Eaux et Améliorations Agricoles. Service des Grandes Forces Hydrauliques. (Région des Alpes.) Comptes rendu et Résultats des Etudes and Travaux au 31 Décembre, 1911. Tome vi. Pp. 404. Annexe du tome vi. Nivellements.

Ist es Wahr dass $2 \times 2 = 4$ Ist? By Fred Bon. Erster Band. Pp. xxviii+523. (Leipzig: E. Reinicke.)

British Rainfall, 1912. By H. R. Mill. Pp. 372. (London: E. Stanford, Ltd.) 10*s*.

A New School Geometry. By R. Deakin. Part ii. Pp. viii+161–202. (London: Mills and Boon, Ltd.) 1*s*. 6*d*.

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