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CONTENTS.

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A Representative Body for Science in Great Britain.

THE invitation sent out by the National Union of Scientific Workers to all those who have made science their vocation, to assist in building up an organisation which shall be fully representative of their various interests, may appear to some to be superfluous. They may argue that the functions which it is proposed this representative body should perform come within the scope of the legitimate activities of existing bodies, the various learned societies, propagandist bodies like the British Association and the British Science Guild, and the professional institutions the members of which are engaged in the teaching and practice of science. Others, while prepared to agree with the statement that none of the existing bodies is fully representative of science and the scientific worker, may feel that this is an advantage rather than a disadvantage, in that it is conducive to the freest expression of the will of the individual. They may fear that the establishment of a code of professional ethics, for example, might result in the growth of a narrow professionalism deadly to the spirit of science.

A hundred years ago similar objections were raised to the formation of the British Medical Association. Some qualified physicians, surgeons, and apothecaries on one hand, and all the quacks on the other, regarded this body with the greatest disfavour, the former because they resented the implication that the existing bodies were not all-sufficient and wished to safeguard their right to control their respective branches of the medical profession, the latter because they were fearful of the material consequences to themselves. Yet it cannot be seriously suggested that the peculiar form of professionalism which was established mainly through the initiative and instrumentality of the British Medical Association has not been of the greatest advantage to the members of that profession and even more to the public. It must be acknowledged that the type of professionalism which insists that the results of ameliorative research should be made available to the whole world, which insists also that the discoverers themselves shall not derive any immediate and direct pecuniary benefit from them, is expressive of the highest ideals of service and calculated to attract to the profession some of the finest spirits of the age. Neither can it be said that the prestige of the Royal Society of Medicine, the Royal College of Physicians or the Royal College of

Surgeons, or the faculties of medicine of the universities of Great Britain suffered through the activities of the democratically constituted body: actually their prestige was enhanced. The medical profession is practically a self-governing body, members of the profession predominate on the General Medical Council, and the Government puts large funds at the disposal of the Medical Research Council, most of the members of which, and the chief administrative officer, are also members of the medical profession. Moreover, they act in an executive capacity, and not merely an advisory capacity like the scientific members of the Committee of the Privy Council for Scientific and Industrial Research.

The suggestion that the proposed body for science is superfluous is disposed of by the signatories and supporters of the present appeal: among them are some who have held or are at present holding high offices in learned societies and professional institutions. In another category is the vague fear that such a body would tend to warp the spirit of the individual scientific worker or restrain his freedom of action in any way. Much would depend on the character of the restraint. It might quite reasonably recommend its members not to apply for appointments where low initial salaries were not compensated for by the prospects of a moderate competency later, or where other conditions of service were notoriously bad. But it is difficult to imagine in what other ways it would fetter the judgment of an individual. It can scarcely be imagined that it would demand a thirty-six-hour week, or that it would exhibit that peculiar vice of modern trade-unionism—the excessive demarcation of function—or even that it would proscribe certain types of research. It is obvious that it must do none of these things. On the contrary, one of its most important tasks might be the freeing of research workers in certain industrial undertakings and government departments and State-aided institutions from many of the unnecessary and irritating restraints from which they suffer to-day—conditions which are only possible because of the lack of organisation among the victims. Just as the British Medical Association broke down the narrow professionalism and exclusiveness of the older sectional organisations, so could the proposed body promote unity among the many distinct and overlapping sectional bodies in science.

It is a little unfortunate that the general newspapers, in commenting on the appeal, have unduly stressed its material aspect, and almost entirely ignored the wider aims outlined. Naturally, a body which exists for the purpose of furthering and protecting the interests of scientific workers must do all in its power to bring about an improvement of the salaries and other conditions of service of its members. The shortage of men and women of the first rank for research has been noted in nearly every report on scientific research which has lately been published, and this shortage is attributed to the slender material attractions of a career which demands not only a rare type of mind, but also the utmost perseverance and self-training. Amateurs of the type of Cavendish and Darwin are few in number. The ranks of research workers have now to be filled by those to whom science must be a profession. "Human nature," stated the *Observer* last Sunday, "would have to be more exalted than it is to secure that the highest gifts would always be devoted to the service of knowledge for a reward much lower than accrues to mediocre grades of business ability." Clearly, it is the duty of the profession of science to ensure that the value put upon its services is sufficient to attract the highest type of recruit.

More is, however, demanded. Scientific workers must be valued not only for their achievements in harnessing the forces of Nature to the service of man, for giving him a greater measure of control over his environment by their successes in the combat against the diseases which afflict human beings, animals, and plants; for the material blessings they bestow on communities, or for the potency of the lethal weapons they have devised. They must be valued for their greatest achievement, the habit of mind which their patient and persevering observations and inquiry has engendered. They can bring to the examination of world problems an outlook which cannot rest content with partial and incomplete solutions. Hitherto, they have been denied the opportunity of directing or sharing the control of the affairs of a civilisation for which they are mainly responsible. Again, the remedy lies with scientific workers themselves. They could, if they were united in a great resolve, make the nation understand the contributions they have to offer to its problems, social problems, industrial problems, problems of finance. It is essentially their function, and not primarily that of a government department, to state the aims and the needs of science, and how best those needs can be met. It is their paramount duty to insist that science should be adequately represented in the councils of the nation, and they could best accomplish that end if they presented

the appearance of a disciplined force instead of unorganised or inchoate and impotent factions.

It may be thought that unity in science will be best accomplished by the formation of a federal council upon which the various learned societies and professional institutions can be represented, rather than by a body aiming at becoming representative of these varied interests on the basis of individual membership. Scientific workers must realise, however, that to be effective, a federal council must have executive authority. It must be in a position, should the necessity arise, to take action involving each and all of the constituent bodies without direct reference to them: in other words, the constituent bodies must delegate large powers to their representatives. The breakdown of the Conjoint Board of Scientific Societies was largely due to the reluctance of the various societies to grant their representatives any such authority; and, in the end, to the Royal Society deciding not to support an appeal to Government for increased aid for the publication of scientific papers. Other attempts to obtain concerted action by the various societies have been equally unfortunate. On the other hand, if scientific workers are of opinion that a representative body able to speak with the authority of the majority of men and women professionally qualified for scientific service by their university degrees or other qualifications, is desirable for the advance of science and civilisation, they should make their wishes known.

Modern Geophysics.

Lehrbuch der Geophysik. Herausgegeben von Dr. B. Gutenberg. Lieferung 1. Pp. 176. 9·75 gold marks. Lieferung 2. Pp. 177-400. 13·80 gold marks. (Berlin: Gebrüder Borntraeger, 1926.)

GEOPHYSICS has now its 'Lehrbuch'; at any rate, it has two-fifths of one at the moment of writing, and the remaining instalments are promised for an early date. The difficulty that no single author can cover the whole subject has been met by obtaining the collaboration of a number of authors, and the whole is under the editorship of Prof. B. Gutenberg, whose distinguished work has already led to great advances in seismology and the study of the propagation of sound. The first two parts are by Profs. A. Born, E. A. Ansel, A. Sieberg, J. Bartels, and Gutenberg himself.

The opening chapter consists of three pages on cosmogony by Born, and gives short summaries of the nebular and planetesimal hypotheses of the origin of the solar system. It is rather unfortunate in mentioning work of mine in support of the planetesimal hypothesis; though the hypothesis I favour starts with the same initial assumptions as the planetesimal hypothesis, to the authors of which I have often expressed my indebtedness, it happens that the principal modification I have found necessary consists in dispensing with the planetesimals, and consequently a different name is needed for the theory I have advocated. The author decides that the primitive earth was fluid; this agrees with my own views, but not with the original form of the planetesimal hypothesis.

Prof. Born then gives a condensed account of the classification of rocks, with much useful information about their composition, mechanical properties, and thermal conductivity. Such information in an accessible form has long been needed; most analysts seem to think that it is much less important to know the density of a rock than whether it contains 0·3 or 0·5 per cent. of titanium. On p. 8 aluminium has somehow escaped mention as a constituent of felspars.

The composition and radioactivity of meteorites are then described, and Prof. Born goes on to the abundance of the chemical elements in the crust. The greater density and basicity of suboceanic rocks in comparison with continental ones are brought out. Data concerning radioactivity are given, but thorium contents are given only for basalts. A very good account of methods of determining geological time follows; De Geer's method for post-glacial time is included. The main geographical features of the earth are described in the next chapter.

There is a remark on p. 52 that the melting-point of basaltic rocks at atmospheric pressure is about 200°-300° C. lower than that of granite ones, which is given as 1100°. F. W. Clarke gives 1240° for granite, and values from 1060° to 1250° for basalt ("Data of Geochemistry," 1924, 298-301). J. H. L. Vogt gives 1250° for the crystallization point of gabbro, which is chemically similar to basalt, and 1000° for granite ("Economic Geology," 1926, 207-233). The latter estimates refer explicitly to dry material, but it seems to be generally believed by geologists that in natural conditions the melting-point of granite is more affected by water than that of basic rocks. A reconsideration of the data on this question is overdue; such a conflict of opinion on some of the most important

experimental data of geophysics should not be allowed to persist.

A useful discussion of gravity and isostasy by Prof. Ansel follows. The account of the differences between the Airy, Pratt, and Hayford views of isostasy is clear and good, and there is a short account of the figure of the earth. The method of reduction of gravity observations is described, with special application to European data.

Movements of the crust are then treated by Prof. Born. Those on a continental scale are treated shortly, and then there is a description of the processes involved in the formation of mountains, with many excellent illustrations and accounts of relevant experiments. Pp. 122-125 are concerned with objections to the contraction hypothesis in general, not merely to the thermal contraction hypothesis. All seem to me quite unsound. One is that the strength required in the crust if it is to support itself like an arch without resting on the interior is many times the crushing strength of rock materials. Of course : but who has said that the crust had to become detached from the interior before it could be crumpled ?

Phenomena of denudation and vulcanism are discussed in the next two chapters, mainly quantitatively.

The section on earthquakes in relation to geology is by Prof. Sieberg. It is concerned mainly with macroseismic data ; there are several striking illustrations showing the fractures, rotations, and other disturbances produced in the neighbourhood of an earthquake. In addition to the ordinary scales of intensity, Prof. Sieberg gives one of his own adapted to disturbances felt at sea. The relations of earthquakes to volcanic and tectonic disturbances, and the physical processes involved in earthquakes, are then treated at considerable length.

The chief types of seismographs are described by Gutenberg in the next chapter. A novelty is an account of the torsion seismograph of Anderson and Wood, which depends on a cylinder mounted on a vertical wire in such a way that its centre of mass is not on the wire. Horizontal disturbances of the ground displace the wire and cause the cylinder to rotate about it. Then Gutenberg proceeds to consider the information yielded by the records of distant earthquakes. Most of his work on this subject has already been published, but not in so convenient a form, and it is so important that a connected account of it is invaluable. On pp. 245-6 tables derived from observation show the times of transmission of the direct P and S waves through the earth. These times are mostly rather shorter than those obtained by Zöppritz and still used as a basis for reductions by Turner ; the differences for P reach about 12 seconds when the epicentral distance is 90°, while those for S are on the whole rather less.

Gutenberg's times have been derived from a discussion of many more earthquakes than were available when Zöppritz wrote, and have been supplemented by the amplitudes of the displacements observed, which afford a valuable check on the times measured directly. In addition, he has used these times to calculate the times of transmission of the various other waves theoretically possible. Following up some earlier work of R. D. Oldham, Gutenberg has found that the earth has an extensive central core where the S (distortional) wave is not transmitted, and the P (compressional) wave travels much more slowly than in the outer parts. This opens up the possibility that any wave incident on the boundary of this core will be broken up into three new waves—compressional waves in both shell and core, and a distortional wave in the shell. Waves incident on the outer surface, again, in general give rise to both compressional and distortional reflected waves. The waves transmitted into the core can undergo further separations when they emerge from it, so that on the whole a very complex picture is presented of the motion produced by a single earthquake shock. In the figure on p. 247 there are 16 curves showing the times of transit of waves to different distances ; originally only three of these were empirical, and all the others are direct inferences from these three by means of the ordinary laws of wave propagation. I believe I am right in saying that every one of these curves has been verified by tracing the derived waves on actual records.

Near earthquakes and surface waves are then discussed, with several other interesting seismological questions, and Prof. Gutenberg then passes on to water waves and tides. The bodily tide, precession and nutation, and the variation of latitude are well, if somewhat briefly, discussed. The last twenty-three pages form the beginning of Dr. Bartels' article on terrestrial magnetism and related phenomena.

That the book should be in the possession of every geophysicist need scarcely be said. Nevertheless one feels at times that the authors' style is cramped for lack of space, and that geophysics is too large for one text-book, even one of a thousand pages. Still the amount of information compressed into the first four hundred pages is astonishing.

HAROLD JEFFREYS.

Intellectual Activities in France.

Statistique intellectuelle de la France: tableaux relatifs à l'enseignement public, aux bibliothèques, aux spectacles, aux publications, préparés sous les auspices de l'Institut International de Coopération Intellectuelle et de l'Institut de Statistique de l'Université de Paris. Par Tatiana Beresovski-Chestov. Année 1923–24. Pp. vii + 124. (Paris: Les Presses universitaires de France, 1926.) 35 francs.

USUALLY, if one wants to discover detailed and comprehensive statistics concerning all kinds of educational machinery from primary, secondary, technical, and art schools to libraries, and even theatres, they must be sought in many (and often elusive) publications. Here they appear in one volume—a recommendation in itself.

It would be easy, of course, to succumb to the usual temptation presented by such a volume, namely, to compare its figures with those available in Great Britain. That is, however, a temptation we shall resist for three reasons. First, it is very difficult to make trustworthy comparisons where various parts of the machinery and their several objectives do not exactly correspond to those in Britain. Secondly, considerations of space would force us to select only those parts of the machinery in which we are specially interested; and, lacking the exact correspondence already mentioned, we would merely confirm the haters of statistics in their sweeping assertion that figures can be made to prove anything. The third reason, however, is the most important. It is that the idea behind this volume is not merely the presentation of many figures which uncontrolled enthusiasts may use to show how much more should be done in the fields which interest them most, or which railers against taxes may use to show in what manner public money is wasted. Nor is it, in the slightest degree, a defence of administration. It is a definite recognition that departmental statistics afford no real evidence of the intellectual progress of a country.

Not yet is it sufficiently realised that education is a process by no means confined to the school. There are libraries and pictures; theatres and cinemas; churches and museums; books and companions: there are also thoughtless parents and heedless employers; and who will doubt the enormous influence of the Press? All these, and countless other important and often unnoticed influences, go to make up the forces which determine intellectual progress. Only when their interlacing and interdependent qualities become more clearly perceived will the waste and sprawling disorder of the methods by which we try to advance become capable of scientific handling and direction.

To the question of how is this perception to be achieved, there are doubtless as many answers as there are difficulties to be overcome; and one of the many difficulties arises out of our inevitable drive towards specialisation—in education no less than in other fields. As the specialist becomes more immersed in his own developing activities, he often becomes less inclined to do more towards co-operation than to utter phrases of pious generalisation in public, while in private he is apt to become contemptuous of what he regards as intrusion. To criticise this attitude too severely is futile. It is, after all, quite comprehensible and is based upon a sound enthusiasm which is of vital importance to the swift destruction of the varied barriers against man's completer knowledge of his environment. Nevertheless, it must never be forgotten that specialisation achieves its highest value only by reason of its relationship to the great unity of knowledge which serves mankind.

In Great Britain the tendency to draw together activities in order to obviate lonely and superfluous endeavour has recently found practical expression—particularly in the direction of securing a clearing-house for all kinds of specialised information—in the formation of the Association of Special Libraries and Information Bureaux. On the statistical side, it is in the category of such movements that we would place the present volume. It does not pretend to be so complete as might be desired. It is, indeed, frankly admitted that the lack of certain information makes the work fall short of the ideal which has inspired it. Its value, however, cannot be over-estimated, and we shall look forward to the next volume (1924–25) which is already promised. In the meantime we cannot do better than conclude by quoting a passage from the introduction:

"Une publication comme celle-ci fait comprendre à quel point nous sommes loin de donner au public les renseignements qui serviraient à évaluer la grandeur et la nature de la production française dans les sciences, les arts, les lettres et l'enseignement et en général l'importance de l'activité intellectuelle de la France. L'Institut International de Coopération Intellectuelle a fait savoir qu'il demanderait à tous les États de bien vouloir examiner les moyens de multiplier les relevés statistiques relatifs à la vie intellectuelle, suivant un plan qu'il leur proposera. Il est certain que l'apparition simultanée de statistiques bien faites sur l'activité intellectuelle de chaque pays pourrait singulièrement servir au progrès général."

Gmelin's 'Handbook.'

Gmelin's Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. Unter beratender Mitwirkung von Franz Peters. (1) System-Number 13: Bor. Pp. xix + 142. n.p. (2) System-Number 5: Fluor. Pp. xvi + 86. n.p. (Leipzig und Berlin: Verlag Chemie, G.m.b.H., 1926.)

INORGANIC chemistry has been so completely transformed within recent years that long before the completion of the seventh edition of Gmelin's well-known treatise, an entirely re-fashioned and comprehensive work, showing but little resemblance to the older editions, has been undertaken by the German Chemical Society. Except for the non-valent gases, which are all grouped into the first section, each element is being issued as a separate part under a specific 'system-number' (not identical with its atomic number), and it is expected that seventy separate parts will ultimately be issued within a decade and that the whole will form twenty-two volumes. Compounds of two elements will be found under the element of the higher serial number. Thus a particular subject will often be divided, *e.g.* boron carbide falls under carbon, whilst boron sulphide falls under boron, but an alphabetical index of subject matter becomes unnecessary. At the beginning of each section on one element there is a full table of contents, a list of abbreviations, an alphabetical register of journals to which reference is made, and also a complete list of system-numbers to facilitate the location of a compound in the complete work.

(1) In order to adhere to the general plan and at the same time to impart to the section on boron a certain independence, it has been found advisable to include condensed but freely annotated accounts of certain topics, which will be discussed in fuller detail at a later stage, *e.g.* several pages are devoted to a description of metallic borides in general, to heteropolyboric acids and organic complexes, and to perborates. The literature has been exhaustively studied—not merely transferred from earlier editions—to the end of 1925, but an addendum of seven pages includes some later material. Several diagrams are inserted in illustration of the relation between electrical conductivity and temperature, the influence of alcohols on the solubility of boric acid, etc.

(2) The section on fluorine is illustrated with excellent diagrams of the apparatus used by Moissan in 1887 in isolating the element, and of the modifications used later by Argo, Meyer, and Sandow, and by Simons. The history of the element, the general and physical properties, electrochemical behaviour and preparation of its compounds, are all dealt with in detail and a considerable amount of attention is given to analytical methods. A comprehensive survey of the results of atomic weight determinations from 1814 to 1925 is included. Amongst optical properties are found values of atomic refraction, wave-lengths in the arc and spark spectra, and even quite recent direct measurements of the $K\alpha$ line obtained by X-ray analysis. The literature has been revised to the middle of 1926. Complex fluorides are catalogued in eight (periodic) groups, with formulæ and a full list of references.

Each part is bound in stiff-paper covers and clearly printed. When complete the 'Handbuch' will be an indispensable work of reference to the specialists in both pure and applied inorganic chemistry, and it will assuredly lighten the tedious labour involved in searching the literature.

Electrometric Methods.

(1) *Hydrogen Ion Concentration: its Significance in the Biological Sciences and Methods for its Determinations.* By Prof. Leonor Michaelis. Vol. 1: *Principles of the Theory.* Authorised translation from the second revised and enlarged German edition by Dr. William A. Perlzweig. Pp. xiv + 299. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 22*s.* 6*d.* net.

(2) *Potentiometric Titrations: a Theoretical and Practical Treatise.* By Dr. I. M. Kolthoff and Dr. N. Howell Furman. Pp. xii + 345. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1926.) 22*s.* 6*d.* net.

(3) *Les ions d'hydrogène: signification, mésure, applications, données numériques.* Par W. Kopaczewski. Pp. ix + 322. (Paris: Gauthier-Villars et Cie, 1926.) 70 francs.

(1) OF recent years the application of potentiometric methods to the determination of conditions of equilibria in aqueous solutions as well as to quantitative analysis has assumed proportions of no inconsiderable magnitude, and has thus created a demand for text-books on the subjects. To English readers the appearance of the second edition in English of Michaelis's well-known volume will prove a welcome addition to the text-books, few in number, which are universally appreciated. It is unfortunate that in this edition the

erroneous calculations of Ghosh, pp. 117-120, on the conductivity of strong electrolytes, have not been eliminated or replaced by those of Milner and Debye and Hückel. The book is specially valuable, as it is the only one of which the reviewer is aware in which the various types of electrification which can be produced at interfaces are described and discussed. In biology, at least, phase boundary membrane and electrokinetic potentials appear to be of the greatest significance.

(2) The volume of Kolthoff and Furman covers a somewhat different field. Here emphasis is laid on the more recent work on oxidation reduction potentials as well as the employment of metal electrodes in volumetric potentiometric analysis. The book is very well written and the conditions necessary for accurate work fully described. Possibly the weakest portion of the text is the descriptive portion in Chapts. vii. and viii. There are many simple and accurate potentiometers now on the market, such as that constructed by the Cambridge Instrument Co. designed specially for this work. These are now employed almost universally in research laboratories and works, and a short description of such might well replace some of the more complicated but no more accurate systems described. It is interesting to note that adsorption of precipitating ions may cause quite serious errors in the end points of various volumetric titrations in which precipitates are formed.

(3) Kopaczewski has confined himself to the potentiometric and colorimetric methods for the determination of hydrogen ions. The theoretical discussion on the nature of electrolytic dissociation and on the various activity coefficients is treated very inadequately, whilst the remainder of the book, chiefly experimental in character, follows the usual course.

ERIC K. RIDEAL.

The General Theory of Relativity.

Les équations de la dynamique de l'éther. Par Prof. Henri Eyraud. Pp. iii + 67. (Paris: Albert Blanchard, 1926.) 12 francs.

THIS monograph, dealing with the general theory of relativity, has a particular interest of its own in so far as it deals with a novel application of a recent generalisation of M. Cartan to the dynamics of the ether. Besides a brief historical introduction of three pages, and an appendix of nine pages on the technique of space and time measurements, there are two chapters, one of nearly thirty pages, dealing with the geometry of the spaces of the relativity theories, and another of nearly twenty pages dealing with the application of the principle of least action to the theories of gravitational and electromagnetic fields.

The first chapter works out, by traditional methods, the generalisation of M. Cartan already referred to, in which the components $\Gamma^i{}_k$ of the affine connexion in Weyl's geometry are no longer assumed to be symmetric in the two lower indices. Consequently a new true tensor arises, namely, the *torsion* $\Lambda^i{}_{jk} = \Gamma^i{}_{jk} - \Gamma^i{}_{kj}$, which plays an important part in the geometry of the generalisation of Weyl's space. The second chapter, which is the novel part of the monograph, introduces an action integral after the fashion of Mie and Weyl, in which the action density is assumed, initially, at all events, to be a function of two tensors of the second order: one, the skew symmetric electromagnetic tensor, which is the rotation of the contracted components of the affine connexion, $\Gamma^k{}_{jk}$, and the other, the gravitational tensor, which is the symmetric part of the contracted Riemann-Christoffel tensor, R_{ij}.

The ether thus defined is deduced from a Riemann space by a projective conformal transformation, and that the vector potential of the electromagnetic tensor, apart from a numerical factor, can be identified with the contracted torsion tensor $\Lambda_j = \Lambda^k{}_{jk}$. With the action density so far defined as a function merely of the electromagnetic and gravitational tensors, the ether is empty, that is, devoid of electric charge and current. When, however, the action density in addition is an explicit function of the contracted torsion tensor, the current vector appears as the partial differential coefficient of the action density with respect to the new tensor. A plausible assumption as to the form of the action density in the general case leads to an energy tensor of the usual type, with a part representing the electromagnetic energy, another part representing the electronic energy, and generally a third complementary part, which has the character of a pressure. The additional hypothesis that the action density depends mainly on the gravitation potentials, g_{ik}, whilst the influence of the electromagnetic and current terms is comparatively small, leads to the results that (1) the Lorentz electrodynamics holds, (2) the atoms are bounded universes with constant total curvature, and (3) the complementary energy is absent, both in the ether and the atoms.

The monograph is very concise, but offers no particular difficulty for readers familiar with the technique of the general theory of relativity. For such readers it will prove to be most interesting.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor 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 Atomic Weight of Silver.

IN NATURE of Dec. 11, 1926, reference is made to the determination of the atomic weight of silver (*Trans. Chem. Soc.*, 1926, p. 2510) by H. Brereton Baker and H. L. Riley, who, by determining directly the ratio Ag : O in pure silver oxide have obtained the value 107·864±0·0013. This work, carried out with the greatest ingenuity and with care and exactitude such as has only been reached by Th. W. Richards and his school, is of cardinal importance. As I have the honour to be chairman of the Sub-Committee for Atomic Weights of the International Commission on Chemical Elements, I have perhaps the right, as well as the official duty, of offering a few critical remarks. I may be allowed to add that I have studied the literature of atomic weights for fifty years and I was the first to propose, in 1888, the adoption of O = 16 as the standard of atomic weights. A like proposal was made almost simultaneously by Venable in America, and, as is well known, this has become the established practice. As the atomic weights of elements cannot as a rule be determined directly in relation to oxygen, secondary standards are required, and the most modern work published by Richards and his school is being carried out by finding the ratios $x\mathrm{Ag} : \mathrm{RCl}_x$ or $y\mathrm{Ag} : \mathrm{RBr}_y$ to determine the atomic weight of R.

The atomic weight of silver has hitherto been a relative quantity, depending upon the atomic weights of other elements, especially chlorine, potassium, lithium, and nitrogen. As I have shown in critical articles in Abegg's 'Handbook,' it must lie between 107·876 and 107·871, and this view was adopted by the International Commission for Chemical Elements in 1925. In this way the classical value 107·930 of Stas (1865) (declared by Ostwald to be exact to the limit ±0·004 !) was superseded.

The best determination of the atomic weight of silver published by the Richards school led them to regard the value 107·876 as probably the best, and I agreed with them.

The acceptance of the results given by Baker and Riley would affect the whole series of results of the Richards school, and if we accept 107·864, chlorine would become 35·452–35·450 and nitrogen 13·999, values highly improbable having regard to the whole chemical and physical-chemical work bearing upon these elements.

After a very careful study of the paper of Baker and Riley, I beg permission to point to a possible experimental error which appears to have been overlooked by the authors. They decomposed silver oxide by heat and fused the metallic silver so obtained in an atmosphere of hydrogen. They do not seem to have considered whether silver is not volatile at its melting point, 960°·5, or a little above this temperature. Now Stas distilled silver with the oxyhydrogen flame, and I found in my work on the atomic weight of tellurium that it may be easily distilled by the flame of air and coal gas. Even on an open support of lime, silver is volatilised by using an ordinary blowpipe, a copious brown deposit (of oxide or possibly colloidal silver) being formed. On heating the metallic silver obtained by the method of Stas in a tube of the hardest Bohemian glass in the vacuum of a Sprengel pump, I found that at a dull red heat a distinct ring of fine particles of metallic silver was deposited on the cooler part of the tube. Silver, therefore, must have a small but appreciable vapour tension even at 400°-500°. Prof. H. Krepelka has observed repeatedly that on heating the purest, finely divided ('atomic weight') silver to its melting point in hydrogen, a distinct sublimate of small globules of metallic silver was formed on the cooler parts of the silica tube. From this I conclude that metallic silver is volatilised to a small extent at a temperature near 1000° to which Messrs. Baker and Riley heated it and fused it in hydrogen. Thus they would find their atomic weight too low.

The question arises what would be the magnitude of this source of error. If we assume the real value of the atomic weight to be 107·871 or 107·876, we can recalculate the data. I have done this, and find that if we attribute the difference of Baker and Riley's value from the value 107·871, the loss of silver on fusing would lie between the limits of 0·13 milligram and 0·006 milligram; if we take silver as 107·876, the loss would lie between the limits of 0·20 milligram and 0·06 milligram. If we take the mean atomic weight 107·864 given by Baker and Riley, the losses would be respectively 0·08 milligram and 0·14 milligram.

These quantities are so small that the silver corresponding to them would not be visible in any way in the quartz tube. I confess that I am surprised to find the above values so small, but I offer an explanation and give details in the full paper that will be published elsewhere.

May I say, in conclusion, that many years ago I contemplated a direct determination of the ratio of the atomic weights of silver and oxygen by reduction in hydrogen or in a mixture of hydrogen and nitrogen at the lowest possible temperature, but I could not carry out this most difficult and delicate work alone.

BOHUSLAV BRAUNER.

Bohemian University, Prague.

THANKS to the courtesy of the Editor of NATURE, we are able to reply at once to the very kindly expressed criticism of Prof. Brauner. He considers that there is a possible source of error in our recent determination of the atomic weight of silver owing to the loss of traces of silver, by volatilisation, during its final melting in hydrogen. It is certain that, at the temperature of 900°, silver does give off some vapour, but we are convinced that no silver left the weighed tube. The silica tube was 17 cm. in length, not more than half of which was heated in the furnace. The rest, shielded from the heat of the furnace by asbestos board, together with the ground joint and narrow glass tube, has a length of 20 cm. They were kept cool by fanning during the whole time of the experiment. The current of hydrogen was very slow, about one bubble in 3 seconds.

It is not possible that the silver, which may volatilise at 900°, should escape in the state of vapour. If it escaped at all, it must have been in the form of fine particles of solid metal, and it seems almost inconceivable that no deposit should ever have been observed throughout the eight years during which the experiments have been going on. In the last eighteen determinations the same pair of silica and glass tubes has been used, and microscopic examination fails to reveal any trace of deposit on the part of the silica tube which was cooled, or in the glass tube. A more certain proof, however, is given by the weighings. In each determination the silver was melted several times in the silica tube until its weight was constant to one or two hundredths of a milligram. If there had been any such loss as Prof. Brauner has suggested, such constancy could never have been attained; the weight of the tube would have shown a constant diminution.

The knowledge of the atomic weight of silver is, as Prof. Brauner says, of such importance, that we have begun a new series of experiments to investigate the volatility and condensibility of silver.

H. B. BAKER.
H. L. RILEY.

Imperial College of Science,
London, S.W.7.

A New Method of Measuring the Absolute Surface Area of a Metallic Catalyst.

IN a previous communication (NATURE, vol. 118, p. 730; 1926) it was shown that simultaneous measurements of the electrical conductivity, and the thickness of the oxide layer on a film of metallic copper supported on china-clay rods, enabled the fractional decrease in surface area on sintering to be evaluated.

The thickness of the oxide film was measured by observation of the surface colour. These results give directly the equivalent air thickness of the oxide film, but to convert them into absolute measure the refractive index of the film must also be known. The mineral cuprite, cuprous oxide, has a refractive index of 2·85 and is cubic; whereas cupric oxide, occurring in the mineral kingdom as tenorite, is anorthic, having values of the refractive index of 2·63 for red light, and 3·18 for blue. Cuprite is translucent, having a red colour; tenorite is more opaque, occurring in scaly black crystals.

The colours shown by the oxide films are so marked that it is evident that in very thin films the absorption is almost negligible in amount. Since the oxide film is of higher refractive index than the air above it, the dispersion will tend to exaggerate the colours shown by films of a given thickness. The film is backed by metallic copper, and it is assumed that the path difference is caused by the passage of the light from the top of the film to the reflecting interface at the bottom and back again. With substances of such high refractive indices, the light in the film will be practically normal to the film in spite of the varying angles of incidence.

Let S = the surface area of the metal forming M grams of oxide spread over the china-clay support;
C = the electrical conductivity of the film;
q = equivalent air thickness of the oxide film;
μ = refractive index of the oxide;
ρ = density of the oxide;
k_c = initial value of the constant in the parabolic law for the fall in conductivity;
k_q = initial value for the equivalent air thickness.

Then the rate of formation of the oxide as a fraction of the total oxide possible

$$\frac{\rho . S}{M . \mu} \cdot \frac{dq}{dt}$$

is equal to the rate of disappearance of the metal, expressed similarly, *i.e.*

$$\frac{1}{C} \cdot \frac{dC}{dt}.$$

Hence we have

$$\frac{S}{M} = \frac{dC/dt . \mu}{dq/dt . C . \rho} = \frac{\mu}{\rho . C}\sqrt{\frac{k_c}{k_q}}. \quad . \quad . \quad . \quad (1)$$

For an activated copper film the following values were found, k_c and k_q being measured at 210° C.:

$k_c = 1{\cdot}52 \times 10^{-2}$; $k_q = 2{\cdot}50 \times 10^{-10}$; $\mu = 2{\cdot}85$ (mean); $c = 0{\cdot}64$; $\rho = 6{\cdot}3$.

Therefore S/M = 5500 sq. cm. per gram of metallic oxide formed.
= 6900 sq. cm. per gram of film.

The area of the supporting china-clay rods for each gram of metallic film was 3200 sq. cm.

It is now possible to complete the comparison of the surface activity of pure electrolytic copper with that of activated reduced copper (*Proc. Roy. Soc.*, A, vol. 110, p. 285; 1926). 2000 sq. cm. of electrolytic copper had an activity that was imperceptible at 370° C., whereas the activity of about 70 sq. cm. of reduced copper was easily detected at 200° C. From the temperature coefficient of the reaction the activity of 540,000 sq. cm. of electrolytic copper would have been imperceptible at 200° C.; hence reduced copper has an activity that is at least 8000 times greater than that of electrolytic copper.

The activity of the smooth surface is very small indeed when compared with the reduced product.

These results, while showing very clearly the order of magnitude of the surface presented by reduced copper, cannot yet be regarded as accurate determinations until the growth of the oxide film has been studied by spectrometric methods. This research is now proceeding.

F. HURN CONSTABLE.

St. John's College,
Cambridge.

Spectrographic Observations of the Second Green Line of the Auroral Spectrum.

IN previous papers on the origin of the auroral spectrum, and recently in a letter to NATURE of Dec. 4, 1926, I have directed attention to the existence of a second green line lying in the region of about λ5230, which should correspond to the line, or rather group of lines, N_2, of the spectrum from solid nitrogen.

As stated in my letter to NATURE, this second auroral line is usually extremely faint and has only occasionally been observed with spectroscopes; in consequence, various observers have found values of the wave-length which differ within fairly wide limits.

On account of the faintness of the line, and also of the fact that the usual photographic plates have a minimum of sensitiveness in this region, I was not able during the early years of my work to obtain this line on my plates.

On a spectrogram made last autumn, however, on a panchromatic plate, I obtained for the first time, after an exposure of forty northern-light hours, this second line; but it was too faint for accurate measurements. The wave-length obtained was 5223.

After this spectrogram had been taken I was able to obtain a sensitiser which gave the plates a high sensitivity in the region wanted. The first exposure with this plate was made in a small spectrograph with fairly high light power and a broad slit. It was exposed at the Geophysical Institute of Tromsø for fifteen effective northern-light hours. On this spectrogram, which gave the ordinary auroral lines much over-exposed, I also now obtained this second green line very well marked on the plate.

The accompanying reproduction (Fig. 1) shows the strong green auroral line marked by *a*, the second green line by *b*, and the strongest lines of the negative band spectrum by *c*, *d*, *e*.

It will be noticed first of all that the second green line is not sharp; although much weaker than the other lines, it covers a greater part of the spectrum. Measurements showed the breadth of the second green line to be 0·22 mm., while that of the other lines, although more strongly exposed, was only 0·15 mm.

From this we can conclude that what is called the second green line is not a single line, but consists of a group of lines.

As stated in my previous letter to NATURE, this

is also the case with the N_2 line from solid nitrogen. This fact, which has also been confirmed by McLennan, was taken by him to be an argument against my theory. We see, however, that the spectrogram obtained for the second green line, on the contrary, in this respect has confirmed my view with regard to the origin of the auroral spectrum.

On account of the small dispersion and the broad slit we cannot at present find the wave-length of the

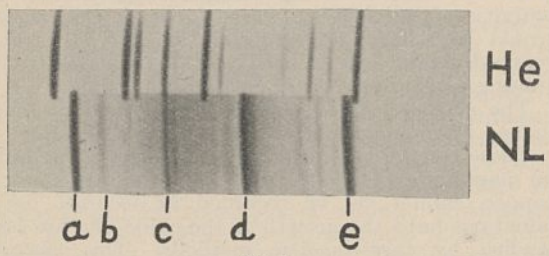

FIG. 1.

various components of the second green line; we have only been able to measure the wave-length of the maximum and limits of the band obtained by our plate. The limits are λλ5220-5269, and for the maximum we find λ5238. On account of the small dispersion, errors of a few angstroms are not excluded.

Comparing this result with those obtained for the luminescence from solid nitrogen, it is of interest to notice that when small quantities of solid nitrogen are condensed in a solid system of inert gases, we find one of the components of N_2, which in certain cases is dominant, to have wave-lengths of λλ5236-5239, *which within the limits of experimental errors correspond to the wave-length found for the maximum of the second green auroral line.* L. VEGARD.

Physical Institute, Oslo, Feb. 11.

Biological Fact and Theory.

PROF. JOHNSTONE'S letter in NATURE of Feb. 26 suggests an analogy. I happen for my sins to be gifted with very poor mathematical powers. Like him, also, on this account I "feel that I may be missing something that will help in an understanding" of the scientific problems with which mathematics are concerned. But I do *not* therefore attempt to belittle mathematical physics as Prof. Johnstone attempts to belittle the results of Mendelism.

He asks "what are the fundamentals of genetics?" The fundamentals of genetics to date are, I take it, the laws of segregation, independent assortment, and linkage; the proof that the chromosomes carry the genes, and that the genes are arranged in linear order; the genetical results of heteroploidy and chromosome aberrations; the individuality of the chromosomes (as, of course, complicated by crossing-over); the normal chromosomal determination of sex; the theory of genic balance; the facts concerning multiple allelomorphs, and multiple, modifying, and lethal factors; the new insight provided by neo-Mendelian methods into species-crosses and into the effects of inbreeding and cross-breeding; the origin of certain variations by point-mutation, chromosome-mutation, genome-change, deficiency, duplication, balanced lethals, and abnormal crossing-over; the demonstration that Mendelism and biometrics are not opposed; the fact that no development is possible at all in the absence of at least one haploid set of chromosomes; the demonstration that genes often determine the *rate* of definite developmental processes. There are doubtless other points which I have forgotten in this hasty survey; but it is absurd to imply that this is not a very considerable achievement and an "ample foundation" for future work.

Prof. Johnstone and Prof. Walker both seem to think that the sum of the genes *cannot* be responsible for the development of the "organism as a whole" or large characters such as the head. But has Liverpool never heard of Boveri's experiments on disperm sea-urchin eggs, published exactly twenty years ago? It may be at present impossible to understand how the sum of the genes is responsible for the development of the organism as a whole, but Boveri made it reasonably certain that it is actually the case.

However, the work of the experimental embryologists, of Child, and of Goldschmidt, is at last beginning to give us an insight into the *how* of this problem—but only by building on the Mendelian foundation which Prof. Johnstone scorns. I would refer critics to Goldschmidt's new book ("Physiologische Theorie der Vererbung") and to a brief critical summary of my own (NATURE, Feb. 23, 1924) as showing how the obvious difficulties of the situation may perhaps be surmounted. I hope to summarise some of the recent work on the relations of hereditary constitution to developmental physiology in an article in NATURE in the near future. Meanwhile I would merely ask Prof. Johnstone whether he, like Prof. Noël Paton, wants to leave on one side all the results of Mendelian work in our attack upon the problem of heredity and its relation to the development of the organism as a whole? That is the only meaning I can attach to his concluding sentences; and it appears to me to be a counsel of despair.

Prof. Walker says (NATURE, Jan. 29, p. 161) that Dobell 'proved' that hereditary characters could not be controlled by chromosomes in certain Protozoa. The main reason advanced by Dobell concerned sex, and was that the Protozoa in question were haploid during all their sexually differentiated phase. If Prof. Walker had been better acquainted with genetical literature he would have remembered that almost simultaneously with Dobell's 'proof,' Wettstein was demonstrating experimentally, and conclusively, the control of sex by chromosomes in another group of organisms in which sex is displayed in the haploid phase—the mosses. Dobell's *a priori* arguments were never even theoretically valid, and long since fell to the ground on confrontation with actual fact.

As to Tornier:—If Prof. MacBride chooses to believe that experiments on developmental physiology, unaccompanied by breeding, have any direct bearing on heredity, I fear I cannot argue with him; to my mind, Tornier's work has just as much (or as little) bearing on the origin of mutations as has that of Driesch or Jenkinson or Child. For the information of readers of NATURE, however, it should be recorded that Berndt (*Zts. Ind. Abst. Vererb.*, 36, 1925) has repeated Tornier's goldfish work, and has also bred goldfish, on a large scale, and fails to verify either Tornier's facts or conclusions save in a few negligible details.

JULIAN S. HUXLEY.

King's College,
Strand, London, W.C.2, Feb. 22.

The Radcliffe Science Library, Oxford.

THE two paragraphs on pages 247-8 of NATURE of Feb. 12, 1927, in reference to the proposed transfer of the Radcliffe Science Library at Oxford to the University of Oxford, have been framed in such a way as to convey a false impression of the facts of the proposed arrangement. The Radcliffe Trustees would therefore be obliged if the following corrections could be inserted:

1. The trustees and the electors have refrained from appointing a successor to the late Dr. Jackson simply in view of the fact that very shortly after his death, negotiations for the proposed transfer were set on foot, pending which it would have been undesirable to make any fresh appointment.

2. In fact, the Library has been during the last few years most admirably carried on by the sub-librarian, Mr. James Ford, whose services the University has recently recognised by conferring on him the degree of M.A., *honoris causa*.

3. The second paragraph is a travesty of what is proposed. Had the writer, or the person who furnished the materials, candidly examined the print of the scheme of transfer which appeared in two numbers of the *Oxford University Gazette* (Feb. 2 and 9, 1927), he must have observed that all existing facilities and privileges of readers and students in the Radcliffe Science Library are preserved with meticulous care, including in particular 'the open shelf' and the right of taking books out into the various scientific departments of the University Museum.

4. In regard to the suggestions which both paragraphs make, that during these three years "the Library has lost many books by theft" (an inevitable source of loss which is in some degree common to all public libraries), the plain fact is that the annual proportion of such losses has fallen very much during the period in question: such books as have been so lost are current text-books of small pecuniary value, and their actual number is exceedingly small.

COTTESLOE.
(Chairman of the Radcliffe Trustees.)

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1. LORD COTTESLOE does not explain why the Radcliffe Trustees, in negotiating the transfer of scientific books to the University, would not have been greatly assisted if they had had the benefit of the inside scientific knowledge of their own Librarian. Their readers have been deprived of his expert aid for *three* years, and that is a long time in the history of a science library, or in the life of an undergraduate.

2. The merits of Mr. Ford and his invariable courtesy on trying occasions are recognised by all who use the Library; but he would be the last person to lay claim to that special knowledge of scientific literature for which generations of Radcliffe Librarians have been famous and helpful.

3. The past success of the Science Library has undoubtedly been partly due to the above-mentioned facilities, wisely given by former Librarians. It is exceedingly doubtful whether the proposed association with the Bodleian Library will lead to the improvement of those facilities. The experience of many a reader is that the difficulties of obtaining books from the Bodleian for use in the Radcliffe Library are so great as to be deterrent.

4. Complaints of undergraduates who, on the eve of examination, are deprived of text-books, even though "of small pecuniary value," evidently ring louder in the ears of their tutors than in those of the Radcliffe Trustees.

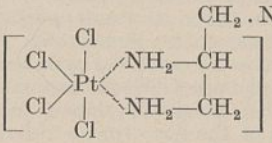
THE WRITER OF THE NOTES.

A Novel Type of Optically Active Complex Metallic Salt.

WERNER'S conception of co-ordinated groups and of auxiliary valency has been extraordinarily useful in classifying and in elucidating the configurations of complex metallic compounds. Although many salts of this class, such as *tris*-ethylenediamine cobaltic chloride $[Co(NH_2 . CH_2 . CH_2 . NH_2)_3]Cl_3$, have been resolved into optically active components, no proof has hitherto been given that an auxiliary valency linking can render a carbon atom asymmetric. This interesting proposition has been now established by the further study of the recently described salt, tetrachloro- (triaminopropane monohydrochloride)-platinum, $PtCl_4, NH_2 . CH_2 . CH(NH_2) . CH_2 . NH_2, HCl$, obtained by the action of the $\alpha\beta\gamma$-triaminopropane hydrochloride on chloroplatinic acid (Mann, *Jour. Chem. Soc.*, 129, 2681; 1926).

In the new salt the components, $PtCl_4$ and two of the NH_2-groups with some of the associated carbon and hydrogen atoms, must lie inside the co-ordinated group, whilst the third NH_2-group must protrude therefrom. It has now been found that the salt can be resolved into optically active components by the aid of silver *d*- and *l*-camphorsulphonate. The two salts, *l*-base *d*-acid, and *d*-base *l*-acid, have thus been obtained in an optically pure state; the hydrochlorides regenerated from these salts give molecular rotations of $-502°$ and $+501°$ respectively for the mercury green line in aqueous solution at 15°.

It is clear, therefore, that the constitution of the hydrochlorides must be represented by the following formula:



In the above formula the enantiomorphism of configuration is associated with asymmetry of the middle or β-carbon atom of the triaminopropane molecule; this asymmetry arises from the attachment of the α- and β-amino-groups to the platinum atom by auxiliary valencies. This is the first case to be recorded in which asymmetry of a carbon atom results from the operation of auxiliary valencies.

The new type of molecular enantiomorphism now disclosed will no doubt appear among numerous complex metallic compounds and, indeed, a complex copper salt, analogous in constitution to the above platinum salt, has been already prepared (*loc. cit.*). We are now engaged on the further investigation of these and other related compounds.

F. G. MANN.
W. J. POPE.

The Chemical Laboratory,
University of Cambridge, Feb. 7.

Migration and Reproductive Rhythm in Birds.

IN a previous letter (NATURE, April 4, 1925) a brief account was given of an attempt to break the annual reproductive rhythm in the Junco (*Junco hyamelis*) and to induce premature recrudescence of the gonads in the middle of the winter. It was suggested that migration might be dependent on the production of a hormone by the organs whilst in a certain stage of regeneration. Thanks to a research grant from the Royal Society, I have this winter been able to repeat and extend my earlier investigations. Nearly two hundred Juncos were trapped on their southward migration in the autumn and divided, as before, between two aviaries. The experimental one has been artificially lit since Oct. 1, beginning on the first day with 5 minutes after darkness, 10 on the second, 15 on the third, and so on. The controls got no artificial light. Their day was therefore decreasing, while that of the experimentals was increasing artificially at about the same rate as it would have been normally in the spring. Neither aviary is heated.

An experimental Junco was killed along with a control on Dec. 30, 1926, and dissected. In this experimental bird the testes were large and conspicuous

and practically in the spring breeding condition. In the control the testes were found to be quite minute. The birds have been exposed to the severest winter weather on record in northern Alberta for at least the last twelve years, involving long spells with below-zero temperatures with a minimum of −35° F. Two canaries (one control, one experimental) which lived with the Juncos under identical conditions and were killed at the end of November 1926, possessed testes in precisely the same condition as those of the Juncos referred to above.

Juncos have been released at intervals. Out of 51 controls liberated between November and March (in two winters), 48 have been retaken alive at the point of liberation. Of the three remaining, one was killed by a cat, one by a shrike, and the last by a blizzard. In other words, it is evident that, regardless of temperature, barometric pressure, weather conditions in general, etc., birds released with their gonads at their resting minimum, stay where they are even though given their freedom hundreds of miles north of their normal wintering grounds. They will not migrate while in this condition.

Out of 36 experimentals released this winter after the first samples, taken at random from the aviary, showed the organs to be developing, 14 have been retaken. The other 22 departed upon release. All the ones retaken have been killed for examination. Without exception their gonads have been in the condition of one or other of the two Juncos referred to above. None with organs in an intermediate stage of development have stayed here upon release. Returns from liberated birds would probably be too much to hope for in the circumstances, but each is ringed with a U.S. Biological Survey band.

WM. ROWAN.

11142—86th Ave.,
Edmonton, Alberta.

Carbon Monoxide Poisoning in the Absence of Hæmoglobin.

WARBURG (*Biochem. Zeit.*, 177, p. 471; 1926) has shown that carbon monoxide depresses the rate of oxygen consumption by yeasts and a micrococcus, and that the amount of carbon monoxide required to produce a given effect increases with the partial pressure of oxygen. He concluded that carbon monoxide competes with oxygen for a catalyst concerned in respiration, as it does for hæmoglobin in vertebrates. He also showed that the affinity of oxygen for this substance is 7-14 times that of carbon monoxide, instead of 1/150 to 1/550 as in the case of hæmoglobin at 15° C., and that, like carbon monoxide hæmoglobin, the compound formed with carbon monoxide is dissociated by light.

I have extended these observations to two higher organisms, namely, the wax-moth *Galleria mellonella* and the cress plant *Lepidium sativum*. The moths behave normally in so little as 2·0 per cent. oxygen at atmospheric pressure provided this gas is diluted with 'nitrogen,' but become motionless in 0·8 per cent. In intermediate concentrations they are feeble and ataxic. When, however, the oxygen is diluted with carbon monoxide, about 16 per cent. of an atmosphere of oxygen is needed for normal behaviour, and in 8·8 per cent. oxygen + 91 per cent. carbon monoxide they are completely immobile. With intermediate amounts of oxygen, smaller amounts of carbon monoxide are poisonous. On admitting air, recovery is rapid and complete.

Cress seeds would not germinate at all in atmospheres containing less than 1·7 per cent. oxygen when diluted with nitrogen, and even in 5 per cent. oxygen growth was poor, though it was almost normal in 10 per cent. When the oxygen was diluted with carbon monoxide there was no germination whatever under 3 per cent. oxygen, and only a few seeds opened in 7 per cent., while in 14 per cent. growth was slow. A comparison of different cultures showed that for a given amount of growth 2-3 times as much oxygen was needed in the presence of large quantities of carbon monoxide as in its absence. Carbon monoxide is therefore relatively less poisonous for cress than for moths or yeast.

The most probable conclusion from these experiments is that oxygen, before it can be utilised for some at least of the oxidative processes in the cell, must combine with a substance possessing a lesser but well-marked affinity for carbon monoxide, these two gases combining with the same group in its molecule. As this substance is found in higher animals and plants as well as bacteria and fungi, it is probably a nearly universal cell constituent. The apparently different ratio of its affinities for carbon monoxide and oxygen in cress as compared with yeast and moths, is of course paralleled in the case of hæmoglobins from different animals.

J. B. S. HALDANE.

School of Biochemistry,
University of Cambridge.

Persistent Lines of Hafnium.

A NUMBER of spectra of zirconium ores and oxides have been examined for persistent lines of hafnium, using the wave-lengths for this latter element given by Hansen and Werner (NATURE, 112, 618; 1923). The most persistent lines observed—three of which were found in all spectra examined—are at wave-lengths

2773·40, 2866·35, and 2919·55 angstroms,

of which the first is the most persistent. Other lines slightly less persistent are 2516·85, 2887·15, 2898·25, 2904·40, (2904·80), 2940·80, 2964·85, 3194·20. (The line 2904·80 is uncertain on account of a strong zirconium line nearby. The hafnium line and its neighbour 2904·40 are possibly a pair like those at 2513·00 and 2512·70. The line 2904·40 is very persistent, but the shorter pair are not.)

On account of the shortness of the range of Hansen and Werner's wave-lengths, none of these lines may safely be considered to be true *raies ultimes*, but their persistence may have some practical utility. In this regard it may be remarked that the crude ores are but slightly more difficult of examination than are fairly pure oxides, in spite of the richness of the preponderant spectra involved. With moderate dispersion (λλ 7000-2100 on a 10-inch plate) and good focus, the number of blends involving strong hafnium lines in the region studied is small and for analytical purposes probably of little moment. In using the ores and oxides of zirconium in a carbon arc, satisfactory spectra were not frequently obtained unless the arc carried enough current to be noisy. When satisfactory zirconium spectra were got there was no uncertainty about the hafnium traces, repeated exposures giving concordant results. Of the ores at hand the richest was of Wisconsin origin, being surpassed only by concentrates from a Carolina ore which was not available in crude state. In addition to the commoner elements in the ores, scandium appeared strongly in several cases.

Regularities in the spectrum of hafnium, to which the persistent lines should be a guide, have not yet appeared satisfactorily. The arc spectrum should be of odd multiplicity; McLennan, McLay, and Smith (*Proc. Roy. Soc. London*, 112, 76; 1926), applying Hund's principles, make the lowest arc term a triplet *F*. Inspection of Hansen and Werner's wave numbers beginning with the differences between the most per-

sistent observed lines reveals a number of apparent triplets, and several triplet combinations having satisfactory intensities and the latter meeting possible inner quantum restrictions. Lacking confirmation such as Zeeman effect, these regularities seem, however, too conjectural to deserve recording at present.

MAX PETERSEN.

New York University.

The Intrinsic Fields in Ferromagnetic Substances.

FROM many points of view it seems evident that the so-called 'molecular field' introduced by P. Weiss into the theory of ferromagnetism cannot be purely magnetic. The magnitude of such a field, if responsible for the ferromagnetic phenomena, would be of the order of 10^7 gauss (in the saturated state). On the other hand, a purely magnetic field of the same order of magnitude, as W. Voigt has pointed out, is required for accounting for the enormous Faraday- or Kerr-effect in ferromagnetic substances. The study of this effect in the infra-red part of the spectrum (where the classical theory of 'free' electrons in metals is fairly valid) seems to make it probable that the so-called 'free' electrons moving between the atoms of iron or nickel are influenced by intrinsic magnetic fields of the order of 10^7 gauss. Thus two independent sources seem to make probable the existence of such enormous magnetic fields. Since both methods are, however, more or less indirect, it seemed worth while to work out a direct experimental method which could give some information as to the fields existing inside a ferromagnetic substance.

As an instrument for studying the intrinsic fields, a narrow beam of real free electrons, β-particles, was chosen. If a magnetic field exists inside a magnetised foil of nickel, it is evident that the beam of β-particles passing through the foil will be deflected. The experimental arrangement was chosen in such a way that fields of the order of 10^4 gauss (that is, fields of the order of the induction actually existing) would remain unnoticed. But fields exceeding 10^5 gauss could be easily detected by the displacement of the traces of β-particles on a photographic plate. Nickel-foils of 0·015 mm.–0·022 mm. thickness were magnetised in fields of about 500 gauss and more.

No difference whatever was detected between photographs taken using magnetised and demagnetised nickel foil. Thus it can be claimed that no magnetic field exceeding 10^5 gauss exists in a ferromagnetic substance.

Further experiments on the passage and scattering of β-particles in ferromagnetic substances are in progress.

J. DORFMAN.

Physical-Technical Laboratory,
Leningrad, Jan. 6.

Action of Magnetic Fields on the Refractive Index of Carbon Dioxide Gas.

IN NATURE of Nov. 20, 1926, p. 734, Messrs. Ghosh and Mahanti report an alteration of refractive index of carbon dioxide on applying a magnetic field of 3600 gauss transversely to the direction of propagation of the light. They attempt to explain this effect by an orientation of the molecules in the magnetic field. Now in a gas the molecules of which are orientated, if any effect on the refractive index were expected, one would naturally anticipate the primary effect would be a double refraction. Krishnan (*Proceedings of the Indian Association for the Cultivation of Science*, 10, 1. 35; 1926) has searched diligently for this effect in pure carbon dioxide over the whole range of pressures used by Ghosh and Mahanti, and his results were uniformly negative. For this reason an effect of the type described could not be due to molecular orientation. Further, the basis for the supposition of orientation in polyatomic gases, namely, the experiments of Glaser on their susceptibility, has been rendered very uncertain by Lehrer (*Ann. d. Physik*, 81, 229; 1926). Using a more satisfactory method, the latter was unable to reproduce Glaser's results. These facts made the experiments of Ghosh and Mahanti very difficult to understand, and it was considered worth while to repeat them.

Fields of 3600 and 6000 gauss were used. The carbon dioxide was prepared by heating pure sodium bicarbonate, and was dried by freezing and over phosphorus pentoxide. A Jamin refractometer was used, illuminated by the green line of mercury, $\lambda = 5461$. The compensating tube was evacuated; the other lay between the poles of an electromagnet. Carbon dioxide was admitted by a leak into the second tube, and at the same time the fringe shift was noted. In all sixty fringes passed the cross-wire for the range of pressure, 0-450 mm. mercury, as opposed to eight in the experiment of Ghosh and Mahanti. On plotting pressure against fringe-shift the same straight line was obtained whether the field was on or off, and on reduction the refractivity agreed to within one-half per cent. with the tabulated value. In fact, the results seem quite inconsistent with the parabolic curve of Ghosh and Mahanti.

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Magnetic Induction in Continuous Media.

CONSIDER a volume τ of any shape, occupied by material of unit permeability, having resistivity ρ (e.m.u.) placed in an alternating magnetic field of arbitrary distribution, sinusoidal in time, with pulsatance p. Let L specify its leading dimension. The three parameters which, together with the applied field distribution, determine the heat generated and the power dynamically conserved in the volume τ, are L, ρ, p. Then if H (e.m.u.) denotes the amplitude of the magnetic field at a particular point, the heat generated can be written

$$H^2 . L^\alpha p^\beta \rho^\gamma f\left(\frac{L^2 p}{\rho}\right) \text{ erg./sec.}^{-1},$$

where the function f depends, *inter alia*, on the distribution of H. It is supposed that the greatest dimension of the volume τ is short compared with $\frac{2\pi c}{p}$.

The argument of f is in effect the only possible adimensional combination of the parameters.

Then $L^\alpha p^\beta \rho^\gamma$ must have dimensions $L^3 T^{-1}$, and may therefore be written $L\rho(L^2 p/\rho)^\beta$ where β is arbitrary. If then we vary any two of the parameters, so as to keep $L^2 p/\rho$ constant, the power dissipated will vary as $L\rho$, $L^3 p$, $\rho\sqrt{\rho/p}$ according to the variables chosen, while for a complete variation, subject only to the above restriction, the power remains proportional to $L^2\sqrt{\rho p}$.

Variation of L has been supposed to take place by a variation of the scale of the space of τ and the field H. Variation of the power dynamically conserved obviously follows the same rules as the power dissipated.

Apparently this principle of similitude has not previously been formally enunciated.

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Physical Aspects of Quantum Mechanics.[1]

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THE purpose of this communication is not to give a report on the present status of quantum mechanics. Such a report has recently been published by W. Heisenberg, the founder of the new theory (*Die Naturwissenschaften*, **45**, 989, 1926). Here we shall make an attempt to understand the physical significance of the quantum theoretical formulæ.

At present we have a surprisingly serviceable and adaptable apparatus for the solution of quantum theoretical problems. We must insist here that the different formulations, the matrix theory, Dirac's non-commutative algebra, Schrödinger's partial differential equations, are mathematically equivalent to each other, and form, as a whole, a single theory. This theory enables us to compute the stationary states of atoms and the corresponding radiation, if we neglect the reaction of the radiation on the atoms; it would seem that in this respect we have nothing more to wish for, since the result of every example in which the calculations are carried out agrees with experiment.

This question, however, of the possible states of matter does not exhaust the field of physical problems. Perhaps more important still is the question of the course of the phenomena that occurs when equilibrium is disturbed. Classical physics was entirely concerned with this question, as it was almost powerless toward the problem of structure. Conversely, the question of the course of phenomena had practically disappeared from the quantum mechanics, because it did not immediately fit into the formal developments of the theory. Here we shall consider some attempts to treat this problem on the new mechanics.

In classical dynamics the knowledge of the state of a closed system (the position and velocity of all its particles) at any instant determines unambiguously the future motion of the system; that is the form that the principle of causality takes in physics. Mathematically, this is expressed by the fact that physical quantities satisfy differential equations of a certain type. But besides these causal laws, classical physics always made use of certain statistical considerations. As a matter of fact, the occurrence of probabilities was justified by the fact that the initial state was never exactly known; so long as this was the case, statistical methods might be, more or less provisionally, adopted.

The elementary theory of probability starts with the assumption that one may with reason consider certain cases equally probable, and derives from this the probability of complicated combinations of these. More generally: starting with an assumed distribution (for example, a uniform one, with equally probable cases) a dependent distribution is derived. The case in which the derived distribution is entirely or partly independent of the assumed initial distribution is naturally particularly important.

The physical procedure corresponds to this: we make an assumption about the initial distribution, if possible, one about equally probable cases, and we then try to show that our initial distribution is irrelevant for the final, observable, results. We see both parts of this procedure in statistical mechanics: we divide the phase space into equally probable cells, guided only by certain general theorems (conservation of energy, Liouville's theorem); at the same time we try to translate the resulting space-distribution into a distribution in *time*. But the ergodic hypothesis, which was to effect this translation, and states that every system if left to itself covers in time its phase space uniformly, is a pure hypothesis and is likely to remain one. It thus seems that the justification of the choice of equally probable cases by dividing the phase space into cells can only be derived *a posteriori* from its success in explaining the observed phenomena.

We have a similar situation in all cases where considerations of probability are used in physics. Let us take as an example an atomic collision—the collision of an electron with an atom. If the kinetic energy of the electron is less than the first excitation potential of the atom the collision is elastic: the electron loses no energy. We can then ask in what direction the electron is deflected by the collision. The classical theory regards each such collision as causally determined. If one knew the exact position and velocity of all the electrons in the atom and of the colliding electron, one could compute the deflexion in advance. But unfortunately we again lack this information about the details of the system; we have again to be satisfied with averages. It is usually forgotten that in order to obtain these, we have to make an assumption about equally probable configurations. This we do in the most 'natural' way by expressing the co-ordinates of the electron in its initial path (relative to the nucleus) in terms of angle variables and phases, and by treating equal phase intervals as equally probable. But this is only an assumption, and can only be justified by its results.

The peculiarity of this procedure is that the microscopic co-ordinates are only introduced to keep the individual phenomena at least theoretically determinate. For practical purposes they do not exist: the experimentalist only counts the number of particles deflected through a given angle, without bothering about the details of the path; the essential part of the path, in which the reaction of the atom on the electron occurs, is not open to observation. But from such numerical data we can draw conclusions about the mechanism of the collision. A famous example of this is the work of Rutherford on the dispersion of α-particles; here, however, the microscopic co-ordinates are not electronic phases, but the distance of the nucleus

[1] Extension of a paper read before Section A (Mathematics and Physics) of the British Association at Oxford on Aug. 10, 1926. Translated by Mr. Robert Oppenheimer. The author is very much obliged to Mr. Oppenheimer for his careful translation.

from the original path of the α-particle. From the statistics of the dispersion, Rutherford could prove the validity of Coulomb's law for the reaction between the nucleus and the α-particle. The microscopic co-ordinate had been eliminated from the theoretical formula for the distribution of the particles over different angles of deflexion.

We thus have an example of the evaluation of a field of force by counting, by statistical methods, and not by the measurement of an acceleration and Newton's second law.

This method is fundamentally like that which makes us suspect that a die is false if one face keeps turning up much more often than every sixth throw; statistical considerations indicate a torque. Another example of this is the 'barometer formula.' Of course, we can derive this dynamically, if we regard the air as a continuum and require equilibrium between hydro-dynamical pressure and gravity; but actually pressure is only defined statistically as the average transport of momentum in the collisions of the molecules, and it is therefore not merely permissible but also fundamentally more sound to regard the barometer formula as a counting of the molecules in a gravitational field, from which the laws of the field may be derived.

These considerations were to lead us to the idea that we could replace the Newtonian definition of force by a statistical one. Just as in classical mechanics we concluded that there was no external force acting if the motion of the particle was rectilinear, so here we should do so if an assembly of particles was uniformly distributed over a range. (The choice of suitable co-ordinates leads to similar problems on both theories.) The magnitude of a force, classically measured by the acceleration of a particle, would here be measured by the inhomogeneity of an assembly of particles.

In the classical theory we are of course faced with the problem of reducing the two definitions of force to one, and that is the object of all attempts at a rational foundation of statistical mechanics; we have tried to make clear, though, that these have not been altogether successful, because in the end the choice of equally probable cases cannot be avoided.

With this preparation we turn our attention to quantum mechanics. It is notable that here, even historically, the concept of *a priori* probability has played a part that could not be thrown back on equally probable cases, for example, in the transition-probabilities for emission. Of course this might be merely a weakness of the theory.

It is more important that formal quantum mechanics obviously provides no means for the determination of the position of particles in space and time. One might object that according to Schrödinger a particle cannot have any sharply defined position, since it is only a group of waves with vague limits; but I should like to leave aside this notion of 'wave-packets,' which has not, and probably cannot be, carried through. For Schrödinger's waves move not in ordinary space but in configuration space, that has as many dimensions as the degrees of freedom of the system ($3N$ for N particles). The quantum theoretical description of the system contains certain declarations about the energy, the momenta, the angular momenta of the system; but it does not answer, or at least only answers in the limiting case of classical mechanics, the question of where a certain particle is at a given time. In this respect the quantum theory is in agreement with the experimentalists, for whom microscopic co-ordinates are also out of reach, and who therefore only count instances and indulge in statistics. This suggests that quantum mechanics similarly only answers properly put statistical questions, and says nothing about the course of individual phenomena. It would then be a singular fusion of mechanics and statistics.

According to this, we should have to connect with the wave-equations such a picture as this: the waves satisfying this equation do not represent the motion of particles of matter at all; they only determine the possible motions, or rather states, of the matter. Matter can always be visualised as consisting of point masses (electrons, protons), but in many cases the particles are not to be identified as individuals, *e.g.* when these form an atomic system. Such an atomic system has a discrete set of states; but it also has a continuous range of them, and these have the remarkable property that in them a disturbance is propagated along a path away from the atom, and with finite velocity, just as if a particle were being thrown out. This fact justifies, even demands, the existence of particles, although this cannot, in some cases as we have said, be taken too literally. There are electromagnetic forces between these particles (we neglect for the moment the finite velocity of propagation); they are, so far as we know, given by classical electrodynamics in terms of the positions of the particles (for example, a Coulomb attraction). But these forces do not, as they did classically, cause accelerations of the particles; they have no direct bearing on the motion of the particles. As intermediary there is the wave field: the forces determine the vibrations of a certain function ψ that depends on the positions of all the particles (a function in configuration space), and determine them because the coefficients of the differential equation for ψ involve the forces themselves.

A knowledge of ψ enables us to follow the course of a physical process in so far as it is quantum mechanically determinate: not in a causal sense, but in a statistical one. Every process consists of elementary processes, which we are accustomed to call transitions or jumps; the jump itself seems to defy all attempts to visualise it, and only its result can be ascertained. This result is, that after the jump, the system is in a different quantum state. The function ψ determines these transitions in the following way: every state of the system corresponds to a particular characteristic solution, an *Eigenfunktion*, of the differential equation; for example, the normal state the function ψ_1, the next state ψ_2, etc. For simplicity we assume that the system was originally in the normal state; after

the occurrence of an elementary process the solution has been transformed into one of the form

$$\psi = c_1\ \psi_1 + c_2\ \psi_2 + c_3\ \psi_3 \ldots,$$

which represents a superposition of a number of *eigenfunktions* with definite amplitudes c_1, c_2, c_3, . . . Then the squares of the amplitudes c_1^2, c_2^2 . . . , give the probability that after the jump the system is in the 1, 2, 3, state. Thus c_1^2 is the probability that in spite of the perturbation the system remains in the normal state, c_2^2 the probability that it has jumped to the second, and so on.[2] These probabilities are thus dynamically determined. But what the system actually does is not determined, at least not by the laws that are at present known. But this is nothing new, for we saw above that the classical theory—for example, for the collision problem—only gave probabilities. The classical theory introduces the microscopic co-ordinates which determine the individual process, only to eliminate them because of ignorance by averaging over their values; whereas the new theory gets the same results without introducing them at all. Of course, it is not forbidden to believe in the existence of these co-ordinates; but they will only be of physical significance when methods have been devised for their experimental observation.

This is not the place to consider the associated philosophical problems; we shall only sketch the point of view which is forced upon us by the whole of physical evidence. We free forces of their classical duty of determining directly the motion of particles and allow them instead to determine the probability of states. Whereas before it was our purpose to make these two definitions of force equivalent, this problem has now no longer, strictly speaking, any sense. The only question is why the classical definition is so useful for a large class of phenomena. As always in such cases, the answer is: Because the classical theory is a limiting case of the new one. Actually, it is usually the 'adiabatic' case with which we have to do: *i.e.* the limiting case where the external force (or the reaction of the parts of the system on each other) acts very slowly. In this case, to a very high approximation

$$c_1^2 = 1,\ c_2^2 = 0,\ c_3^2 = 0 \ldots,$$

that is, there is no probability for a transition, and the system is in the initial state again after the cessation of the perturbation. Such a slow perturbation is therefore reversible, as it is classically. One can extend this to the case where the final system is really under different conditions from the initial one; *i.e.* where the state has changed adiabatically, without transition. That is the limiting case with which classical mechanics is concerned.

It is, of course, still an open question whether these conceptions can in all cases be preserved. The problem of collisions was with their help given a quantum mechanical formulation; and the result is qualitatively in full agreement with experiment. We have here a precise interpretation of just those observations which may be regarded as the most immediate proof of the quantised structure of energy, namely, the critical potentials, that were first observed by Franck and Hertz. This abrupt occurrence of excited states with increasing electronic velocity of the colliding electron follows directly out of the theory. The theory, moreover, yields general formulæ for the distribution of electrons over the different angles of deflexion, that differ in a characteristic way from the results that we should have expected classically. This was first pointed out by W. Elsasser (*Die Naturwissenschaften*, **13**, 711, 1925) before the development of the general theory. He started with de Broglie's idea that the motion of particles is accompanied by waves, the frequency and wave-length of which is determined by the energy and momentum of the particle. Elsasser computed the wave-length for slow electrons, and found it to be of the order of 10^{-8} cm., which is just the range of atomic diameters. From this he concluded that the collision of an electron with an atom should give rise to a diffraction of the de Broglie waves, rather like that of light which is scattered by small particles. The fluctuation of the intensities in different directions would then represent the irregularities in the distribution of the deflected electrons. Indications of such an effect are given by the experiments of Davisson and Kunsmann (*Phys. Rev.*, **22**, 243, 1923), on the reflection of electrons from metallic surfaces. A complete verification of this radical hypothesis is furnished by Dymond's experiments on the collisions of electrons in helium (NATURE, June 13, 1925, p. 910).

Unfortunately, the present state of quantum mechanics only allows a qualitative description of these phenomena; for a complete account of them the solution of the problem of the helium atom would be necessary. It therefore seems particularly important to explain the above-mentioned experiments of Rutherford and his co-workers on the dispersion of α-particles; for in this case we have to do with a simple and completely known mechanism, the 'diffraction' of two charged particles by each other. The classical formula which Rutherford derived from a consideration of the hyperbolic orbits of the particles, is experimentally verified for a large range; but recently Blackett has found departures from this law in the encounters between α-particles and light atoms, and has suggested that these might also be ascribed to diffraction effects of the de Broglie waves. At present only the preliminary question is settled, of whether the classical formula can be derived as a limiting case of quantum mechanics. G. Wentzel (*Zeit. f. Phys.*, **40**, 590, 1926) has shown that this is in fact the case. The author of this communication has, furthermore, carried through the computation for the collision of electrons on the hydrogen atom, and arrived at formulæ which represent simultaneously the collisions of particles

[2] We may point out that this theory is *not* equivalent to that of Bohr, Kramers, Slater. In the latter the conservation of energy and momentum are purely statistical laws; on the quantum theory their *exact* validity follows from the fundamental equations. Statistical considerations only apply to quantities, like the angles of deflexion in a collision, which could not be quantised on the Bohr theory of angle variables.

of arbitrary energy (from slow electrons to fast α-particles). As yet this has only been carried out for the first approximation, and so gives no account of the more detailed diffraction effects. This calculation thus yields a single expression for the Rutherford deflexion formula and the cross section of the hydrogen atom for electrons in the range studied explicitly by Lenard. The same method leads to a calculation of the probability of excitation of the H-atom by electronic collision, but the calculations have not yet been completed.

It would be decisive for the theory if it should prove possible to carry the approximation further, and to see whether it furnishes an explanation of the departures from the Rutherford formula.

Even, however, if these conceptions stand the experimental test, it does not mean that they are in any sense final. Even now we can say that they depend too much on the usual notion of space and time. The formal quantum theory is much more flexible, and susceptible of much more general interpretations. It is possible, for example, to mix up co-ordinates and momenta by canonical transformations, and so to arrive at formally quite different systems, with quite different wave functions ψ. But the fundamental idea of waves of probability will probably persist in one form or another.[3]

[3] Compare the article of Dr. P. Jordan, "Philosophical Foundations of Quantum Theory," to appear in a later issue of NATURE.

Benedictus de Spinoza.

By Prof. G. DAWES HICKS.

FIFTY years ago a memorable gathering of distinguished men assembled at The Hague, under the presidency of Prince Alexander of the Netherlands, on the occasion of the two-hundredth anniversary of Spinoza's death. They met in a building which was only a few yards away from the house in the Paviljonensgracht where the philosopher had spent the last few years of his life, and where on Feb. 21, 1677, he died. The principal speaker at that gathering was Ernest Renan; and, having in mind the monument about to be erected, and referring to the humble dwelling hard by, Renan exclaimed: "From his granite pedestal Spinoza will teach us all to follow the way which he found to happiness, and, centuries hence, men of learning, crossing the Paviljonensgracht, will say to themselves, 'It is perhaps from this spot that God was most nearly seen.'" The statue was finished in 1880; and now, on the two-hundred-and-fiftieth anniversary of Spinoza's death, it is proposed to complete the memorial by acquiring the house, to be called the *Domus Spinozana*, and equipping it as a home for research and as a meeting-place for scientific workers of various nationalities. It will be a fitting tribute to one of the world's greatest minds.

The story of this lonely thinker's life has frequently been told. Born at Amsterdam, whither his father had migrated from Portugal about thirty years previously, on Nov. 24, 1632, he spent the whole of his days in Holland. His mother died when he was barely six years old, and his father when he was twenty-two. Two years after his father's death he was excommunicated by the Rabbis; and from that period onwards he lived in modest lodgings, supporting himself at first partly by teaching and partly by grinding lenses for spectacles and optical instruments, in which latter occupation he persevered to the end. Until 1660 he remained in Amsterdam, where he became the leading spirit of a small circle of friends, who after his departure met periodically to discuss philosophical papers which he sent to them. From 1660 until 1663 he resided in Rhynsberg, near Leyden, and there he wrote the "De Intellectus Emendatione," part of his exposition of Descartes' "Principia" with the appendix, "Cogitata Metaphysica," and perhaps a portion of the "Ethics." In 1663 he removed to Voorburg, near The Hague, and stayed there until 1670. At Voorburg he was at first occupied with the "Ethics," but laid it aside in order to devote himself to the "Tractatus Theologico-Politicus," which seemed to him to be the more urgently needed, and which was published anonymously in 1670. In 1670 he removed to The Hague, where he remained until his death in 1677. Here he finished the "Ethics" and wrote the unfinished "Tractatus Politicus," both of which were published in the "Opera Posthuma," that appeared before the end of the year 1677. Nearly two centuries later there was discovered and published the Dutch text of a work of Spinoza's which appears to have been called "Tractatus de Deo et homine ejusque felicitate," written about the year 1660.

At the beginning of the treatise "De Intellectus Emendatione," Spinoza relates the circumstances that led him to devote himself to philosophical inquiry. The ordinary objects of human pursuit —sensuous enjoyment, wealth, station—had all evinced themselves, even when attained, as incapable of yielding real and lasting happiness. The reason seemed to him to be due to the fact that, while these objects are invariably transitory and fleeting in character, in making them ultimate ends men take them to be permanent and self-sufficing. True blessedness (*beatitudo*) could come only from being in possession of a changeless and abiding object of love, and there is, he was assured, no way of obtaining that possession save by knowing things as they actually are. For it was because in everyday experience our apprehension of things is fragmentary and piecemeal, because we contemplate them in isolation and from a limited point of view, that we are misled into desiring some of them as though they could constitute for us the supreme ends of life.

Scientific knowledge would, on the other hand, reveal the interconnexion of finite events, their dependence upon each other, and upon reality as a whole. The Whole alone could be perfect and eternal; and love of it could alone satisfy the

soul's yearning. But the soul can only love what it knows; in order to be in harmony with the Whole, the mind of man must gain a more or less clear insight into its nature. To have a conception of the Whole would amount to having a conception of the eternal and necessary order of the universe; and, since "we needs must love the highest when we see it," would mean the attainment, on our part, of full and complete satisfaction of desire. It was, then, because he was convinced that knowledge is the way to blessedness, that Spinoza set forth upon the intellectual quest, and did not touch the problems of ethics until he had first sought to unravel the general structure of reality.

Spinoza's philosophy takes its start from the fundamental distinction between 'substantial' or self-dependent being and 'modal' or dependent being,—the distinction, in other words, between that which is 'in itself' (*in se*) and is conceived 'through itself' (*per se*) and that which is 'in another' (*in alio*) and is conceived through that other (*per quod etiam*). It had been, indeed, a cardinal principle of the Aristotelian philosophy that what Aristotle called primary substance was marked off from other kinds of being in virtue of the fact that in a proposition it could only stand as the subject, and never as the predicate, or as the quality of anything else. But, in Aristotle's view, finite individual entities were substances in this sense, whereas Spinoza's contention is that, when we have regard to its antecedents, there is no finite individual entity that does not forfeit its supposed substantive character and turn out to be itself predicable as a phase or modification of something else. Consequently, there can be but one self-dependent Being or Substance, namely, Reality, in its absolute entirety and completeness. What we take to be independent, substantive entities, whether physical or mental, must ultimately evince themselves as derivative 'modes' or states of the one absolute Being, ways in which that one absolute Being expresses or manifests itself.

The originality of Spinoza's thought comes strikingly to light in his determined and resolute effort to work out this conception. Substance, as that which is self-dependent, as *causa sui*, or the Unconditioned, must, he argued, be conceived as necessarily existing; in regard to it, that is to say, the question of origin or genesis cannot be raised. The existence of one finite event may legitimately enough be accounted for as the effect of another finite event, and that again as the effect of another, and so on in a never-ending series. But Substance is not an event, not even one colossal event, overlapping all others. It is that which must be presupposed in order that happenings or events should be at all. There can only be a coming-to-be *within* the realm of being. Accordingly, whoever admits the existence of any event, even that of his own act of thinking, is bound to admit the existence of that without which the existence of events would be inconceivable; and, since coming to be and ceasing to be form no part of the content of the Self-existent, this means that Substance must be 'eternal,' *i.e.* timeless, in character, that the Self-existent must be regarded as an eternal truth, which cannot be explained in terms of time or duration, even though that duration be thought of as unbounded in both directions.

Further, from the notion of the Self-existence there follows that of the infinitude of Substance. For as self-existent, Substance must, so Spinoza argues, be unique, and its uniqueness would be destroyed were it limited or restricted by other Self-existents. Just, however, as the term 'eternity' does not properly mean endless duration, so the term 'infinity' does not properly mean endless extent. Substance is infinite in the sense of being the self-contained, the self-complete; its infinity is involved, that is to say, in its unconditioned nature. So, too, Substance is one or a unity, not however in the numerical sense of being a member, even the single member, of a class, but in a sense in which ideas of number are inapplicable. Once more, Substance as complete, is perfection, yet again not in any sense that would imply the gradual realisation of a plan, the unfolding of something not yet actual, but in the sense that it is throughout all that it has in it to be.

Lastly, Substance is the cause of all things, and, indeed, ultimately the only cause. Still, the term 'cause' carries with it, in this context, no implication of producing or creating. To say that Substance is the cause of all things is to say that all things flow from the nature of Substance with the same timeless necessity as the equality of its three angles to two right angles follows from the nature of a triangle. By the term 'cause,' when used in reference to Substance, Spinoza understood, that is to say, logical ground or reason. As a logical ground involves its consequents, so the consequents of the supreme ground are not to be thought of as independent of it but as implicated essentially in it.

The supreme ground, thus conceived, is called by Spinoza indifferently 'Substance,' or 'Nature,' or 'God'; and by each of these terms he means simply Being in its fullness and completeness, that which comprises within its indivisible unity all the positive characteristics in which reality is expressed. What, in fact, he was concerned to maintain was that the notions which we apply legitimately enough to parts of the universe—notions of temporal sequence, change, producing cause, evolution, and so on—become unintelligible and meaningless when applied to the universe as a whole. To speak, for example, of 'cosmic evolution,' if by that be intended the evolution of the totality of things, is, he would have urged, a contradiction in terms. For evolution implies not only that which is evolving, but also an environment with which it is in interaction, and obviously there can be no environment of the totality of things. Not only so. Whoever pictures the universe in its entirety as evolving must inevitably be pulled up before the *impasse* of a first beginning. He would have to start with something, such, for example, as Herbert Spencer's 'indefinite, unstable homogeneity,' that 'once upon a time' appeared upon the stage of being. But, in that case, the philo-

sophic problem centres precisely there; and so long as the 'something' remains unaccounted for, not a step has been taken towards the solution of that problem. Against all such ways of regarding the system of things, Spinoza insists upon conceiving it as an organic Whole, consisting of unconditioned and conditioned, of supreme ground and dependent consequents.

With this conception of God, or the Absolute, Spinoza had evidently left the somewhat halting conclusion of Descartes and the Cartesians a long way behind. It was no longer possible to ascribe to material things on one hand, and to minds on the other, the separate and independent existence which these thinkers had claimed for them. Material things and minds could be no other than 'modes,' phases, states (*affectiones*) of the one ultimate Reality. If, now, we proceed to inquire how the modes are related to one another and to Substance, we come upon the notion of 'Attribute,' concerning the significance of which much difference of opinion prevails. One interpretation, at any rate, it seems to me, merits unreserved rejection. Spinoza could not have meant that the Attributes are real forces or kinds of energy (*Urkräfte*, as Kuno Fischer has it) of which God or Substance is the bearer. For that would have been palpably inconsistent with wellnigh everything he had laid down with respect to the nature of Substance. What could one make, for example, of the 'eternity' of Substance (in which "there is no *when*, no *before*, and no *after*") were one to conceive of its essence as being constituted by potencies or powers of this description? And how, again, could the unity of Substance be retained, if its essence is to be thought of as made up of various kinds of energy—physical, mental, and possibly many others—operating along distinct, though parallel, lines of activity? If Substance be prior to and more universal than these streams of energy, then the latter would become, according to Spinoza's definitions, 'modes,' for each would have something in common with the others, and could not, therefore, be conceived through itself and in itself, in such a way that its conception did not involve the conception of anything else. If, on the other hand, Substance be not more universal than the Attributes, then, on the interpretation in question, it would inevitably resolve itself into a plurality of independent powers, which could only be externally connected.

No doubt any interpretation of Spinoza's meaning is exposed to criticism, but probably Sir Frederick Pollock's suggestion that the Attributes were intended to be taken as 'aspects' of Substance is most nearly in accord with the statement that "Attribute is what intellect apprehends of Substance as constituting its essence." As has often been pointed out, this statement implies by no means that the Attributes are merely our subjective ways of conceiving Substance. For that which is grasped by the 'intellect' (as contrasted with 'imagination') would be, according to Spinoza, objectively real. What, then, I take him to mean, is that there are not two realms, a realm of Extension and a realm of Consciousness, but that it is one and the same reality which manifests both aspects, that everything extended is at once also conscious, and everything conscious is at once also extended. All *res particulares* are, that is to say, regarded from one point of view, modes of Extension, and, regarded from another point of view, modes of Consciousness; all are, as he expresses it, *animata*, although in different degrees.

It is perfectly true that in tracing the descent from the Unconditioned to the Conditioned the idea of agency has at some stage to be introduced, and equally certain that then the crucial difficulties of Spinoza's philosophy are full upon us. Adopting a familiar device, Spinoza endeavoured to effect the passage from the infinite to the finite, from *Natura Naturans* (Nature as ground) to *Natura Naturata* (Nature as consequent, or as a system of modes), by inserting a number of intermediary terms in order to bridge the gap. He introduced, in fact, two grades or classes of what he called 'infinite modes'; first, those which follow immediately from the Attributes, and secondly, those which follow from the Attributes when already modified. On the side of Extension, motion and rest, on the side of Consciousness, the absolutely infinite intellect, are the immediate infinite modes, while the mediate infinite mode on the side of Extension is 'the form of the whole universe' (*facies totius universi*), that on the side of Consciousness not being named. Under cover of these intermediaries the element of activity enters full fledged upon the scene, though how it is supposed to emerge is veiled, it must be confessed, in obscurity. Motion follows, we are told, directly from extension. But does it? Motion may no doubt be said to depend upon extension, but in what sense can it be said to follow from it? If extension be extension simply, it cannot give rise to what is more than itself. Nor would the difficulty be surmounted by identifying extension with physical energy, for physical energy already involves motion, and there would be, in that case, no transition from Attribute to infinite mode.

The attempt not only to conceive an ultimate unity in which all determinate existents have their ground, but likewise to work out logically the conception, was, indeed, a tremendous undertaking, and Spinoza's philosophy will always stand as one of the most sustained efforts in the history of human thought to solve its deepest problem. No one would be concerned to claim that he actually accomplished the whole task which he prescribed for himself. Few would now, I take it, venture to dispute the judgment that in the long run the modal system and the supreme ground fail to come together in one coherent view, that the temporal existence of modes obstinately refuses to fit into the timeless being of Substance. On one hand, it is contended that all things which follow from the absolute nature of any Attribute of Substance must exist eternally and be infinite, and that that which is finite and has a determinate existence can not be produced by the absolute nature of any such Attribute. On the other hand, it is maintained that a deter-

minate existent thing cannot be determined to exist or to act, unless it be so determined by another cause which is also finite and has a determinate existence, and so on *ad infinitum*. That is to say, a determinate existent thing has a positive reality in so far as it expresses the eternal essence of Substance, but in so far as it is finite, in so far as it is limited and restricted, it has not. Yet it is precisely in this latter capacity that modes function as causes in the modal sphere, and thus serve to account for the existence of each other. Modal existence has to be recognised as a fact, though it falls apart from substantial existence, and the chasm widens as the character of the former comes to be more closely scrutinised. But criticism is comparatively easy, constructive thinking is difficult. When criticism has in this connexion said its last word, there will remain in Spinoza's constructive achievement amply sufficient to entitle him to the lasting gratitude of those who in his spirit strive to carry on the work of philosophical inquiry.

Obituary.

MR. J. J. LISTER, F.R.S.

WITH the death of J. J. Lister on Feb. 5 in his home at Grantchester, there passes away one of the band of younger zoologists who, under the leadership of Francis Maitland Balfour, helped to build up the reputation of the Cambridge school of zoology. Although he was most widely known for his important researches on the morphology and reproduction of the Foraminifera, he was a man of liberal interests in many branches of zoology and a keen and accomplished naturalist. Those of us who were his friends and colleagues in the 'eighties vividly remember not only his charm of manner but also the bright and stimulating conversation with which he enlivened our social meetings. There seemed to be few subjects within the wide range of natural history about which he had not something interesting to say. At the same time he was to the undergraduates of his generation a hero in the athletic world. As stroke of the first boat of the Lady Margaret Boat Club from 1878 until 1882, he led his men to many victories both on the Cam and at Henley, and later he was often seen on the river as stroke of the "Ancient Mariners."

Born at Leytonstone in 1857, Lister was the son of Mr. Arthur Lister, who was himself a fellow of the Royal Society and brother of Lord Lister. From an early period of his life, therefore, he must have been associated with men of scientific tastes and initiated into some of the mysteries of biological problems. His father was an authority on the Mycetozoa and published many important papers on this group of organisms. J. J. Lister and his sister took part in these investigations and added materially to the common stock of knowledge that the family possessed. It was not surprising, therefore, that when he wrote the article on Mycetozoa for Lankester's "Treatise on Zoology," it was rightly appraised as the most authoritative summary of our knowledge of the group in the language. But Lister was destined to achieve great personal fame for his work on another group of protozoa. The dimorphism of the species of Foraminifera was already known, but Lister showed, by the most careful investigations of the Polystomella of our own seas, that the two forms are not male and female respectively as had been suggested, but that each produces free swimming spores and that the spores of one of them may be sexual spores, although he failed to prove that the process of conjugation actually took place. His researches on Orbitolites, Quinqueloculina, Polytrema, and other Foraminifera also produced valuable additions to our knowledge of the group.

After taking his degree Lister entered St. Bartholomew's Hospital with the intention of entering the medical profession, but owing to ill-health he abandoned the idea and travelled for some years, first in a sailing ship to Australia and afterwards in H.M.S. *Egeria* in the Pacific Ocean. During this voyage in the surveying sloop, when he had the opportunity of visiting several remote and interesting islands, his ability as an accomplished man of science showed itself in the records of several important observations he made on various subjects. A short paper on the birds of Phœnix Island, in which he described the nesting habits of the frigate birds; an account of the natives of Bowditch Island; and the important conclusion he reached by his study of the islands of the Tonga Group, that, contrary to the Darwinian hypothesis of subsidence, coral reefs and atolls are formed in some regions where the land is undergoing elevation, were some of the varied contributions to knowledge that resulted.

Among the collections he brought home were some specimens of the coral Millepora beautifully preserved in spirit with the zooids expanded, and these he most generously handed over to the writer of this article for further study. They are undoubtedly the only specimens in which the expanded zooids have been seen in Great Britain, for in all the other material that has been collected the zooids are so tightly contracted as to be useless for demonstration purposes. He also brought back some specimens of the young stalked form of the coral Fungia, described by Stutchbury in 1830, and wrote a paper on the strobilisation of the genus.

During the later years of his life, long and continuous ill-health led to a retired life in his home in Grantchester, and his visits to the University Museum and Laboratory became more and more infrequent. But his interest in natural history never waned, and he devoted his energies to a searching investigation of variation in British Lepidoptera.

Lister was made a fellow of his College (St. John's) in 1899, and elected to the fellowship of the Royal Society in 1900. He was president of Section D of the British Association at the York meeting in 1906, and for many years an active member of the council of the Marine Biological Association. S. J. H.

PROF. E. H. RENNIE.

DR. E. H. RENNIE, whose death in South Australia was recently announced, was for more than forty years professor of chemistry in the University of Adelaide. Born on Aug. 19, 1852, he was the son of E. A. Rennie, Auditor-General of New South Wales, and grandson of James Rennie, who was professor of zoology at King's College, London, 1830–1834. His school days were spent in Sydney, and he graduated at the University of Sydney in 1870. For a few years he taught in the Sydney and Brisbane Grammar Schools, and in 1877 came to London to study chemistry. He obtained his doctor's degree in the University of London in 1881. While in London he was assistant for two years to Dr. C. R. Alder Wright in the Chemical Department of St. Mary's Hospital Medical School, and also taught occasionally in the Royal College of Science. On his return to Australia he found employment in the Government Analyst's Department in Sydney. In 1885 he was appointed Angus professor of chemistry in the University of Adelaide, in which capacity he rendered fine service.

Rennie's natural temperament and his upbringing gave him a strict view of his obligations, and he shrank from no labour that would enable him to fulfil them. It must be added that if he expected much from himself, he also expected that his students would do their full share. But his kindliness and sympathy tempered his sense of what was to be demanded from those whom he taught, and he was liked even as much as he was respected. His thorough knowledge of his subject and his sound training in the laboratory, with his capacity for clear expression and his wide outlook, made him an excellent teacher. Outside his own department he was devoted to the general work of the University, and he took a large share in the direction of its rapidly growing activities. He played a leading part in the institution of technical education in Adelaide, and was a warm supporter of the Australasian Association for the Advancement of Science. He also found time to do some research work, principally on the chemistry of Australian products.

Rennie was thoroughly happy when he was able to get away from his work to his boat and his fishing. His enjoyment on all such occasions was only matched by his disreputable appearance: many stories were told of his adventures by those who were invited to accompany him on his cheerful expeditions.

It was fortunate for the young University of Adelaide that its staff should include from early times and for so long a professor of such ability, integrity, good judgment, and tact. He set a fine standard at the moment when naturally it was most valuable; he was trusted by every one inside the University and out; and he helped materially to establish the University of Adelaide in a strong position and to build up its present good reputation.

MAJOR J. R. ERSKINE MURRAY.

MAJOR MURRAY was born in Edinburgh in 1868. At the University of Glasgow he studied under Lord Kelvin, and during the final years of his six years' course he did useful research work. He then entered Trinity College, Cambridge, as a research student. After being an assistant professor for two years at the Heriot-Watt College, Edinburgh, he was appointed an experimental assistant to Marconi. His interests now became centred in radio work. He acted as a demonstrator at University College, Nottingham, and as lecturer to the George Coats Technical College at Paisley. In 1907 he started consulting work in radio-telegraphy and gave lectures on it to Faraday House, London, and other colleges. In 1913 he became a partner in the firm of Messrs. Clarke, Forde, Taylor, and Erskine Murray, consulting engineers.

During the War Dr. Erskine Murray served with the Royal Air Force, being in charge of the radio instruments. He then became Experimental Engineer at H.M. Signal School, Royal Naval Barracks, Portsmouth.

Dr. Erskine Murray contributed several papers to various societies. Shortly after the War he gave to the Institution of Electrical Engineers a practical demonstration of communication by radio-telephony with an aeroplane in flight over London. His best-known book is a handbook on "Wireless Telegraphy," first published in 1907, which has gone through several editions, each edition having to be subjected to a thorough revision owing to the rapid progress of the art. He translated Ruhmer's "Wireless Telephony," to which he contributed a useful appendix. He also wrote a small but useful treatise on "Wireless Telephones and how they Work."

As an experimenter Erskine Murray's ability was of a high order. He took great pains in preparing experiments for his lectures, although he often used the very simplest apparatus. He had the gift of being able to communicate some of his enthusiasm to his students. His death after a very short illness has come as a great blow to his many friends.

WE regret to announce the following deaths:

Mr. H. B. Goodwin, formerly examiner in nautical astronomy at the Royal Naval College, Greenwich, and the author of various works on this subject, on Feb. 24, aged seventy-nine years.

Mr. F. B. Guthrie, chemist in the Department of Agriculture, New South Wales, for some thirty years, and author of papers in Thorpe's "Dictionary of Applied Chemistry" and technical periodicals, on Feb. 7, aged sixty-five years.

Dr. Leopold Spiegel, extra-ordinary professor of the University of Berlin, who died suddenly on Jan. 3 at Charlottenburg in his sixty-second year. Prof. Spiegel, whose numerous investigations were chiefly upon alkaloids, was the discoverer of the drug yohimbin. He was also the author of several books on pharmacology, drugs, poisons, etc. For many years he was a member of the editorial board of the *Chemische Centralblatt*.

News and Views.

TO-DAY is the centenary of the deaths of Volta and Laplace, who both died on Mar. 5, 1827, Volta being eighty-two years old and Laplace seventy-seven Though in intellectual power Laplace was probably far superior to Volta, it may be that the electrical discoveries and inventions of Volta have had a greater effect upon the progress of civilisation than the profounder studies of Laplace. Each, however, in his own sphere did work which will cause his name to be recalled so long as science is studied. Volta's great contribution to science, the Voltaic pile, was made known in 1799, and that year also marked the publication of Laplace's immortal work "Mécanique Céleste."

VOLTA was born at Como in 1745 and came of a noble and ancient family. By 1774 he was holding a post in the Liceo at Como, and there, in the following year, he invented the electrophorus. Four years later he was appointed to the chair of physics in the University of Pavia. There were many students of electricity and magnetism during the eighteenth century, such as Gray, Canton, Dufay, Franklin, Nollet, Coulomb, Priestley, and Cavendish, and to these must be added Galvani, professor of anatomy at Bologna. Galvani for some years studied muscular contraction, especially in frogs, due to electric influence, but whereas Galvani attributed most of the effects obtained to animal electricity, Volta declared they could be traced to the contact of two metals in the presence of moisture. The landmarks in the history of the subject were Galvani's papers to the Bolognese Transactions in 1791, Volta's letters to Cavallo read to the Royal Society in 1793, and Volta's letter to Sir Joseph Banks read to the Royal Society in 1800. He had been awarded the Society's Copley medal in 1794, but it was in his letter of 1800 that Volta described the Voltaic pile and the "Couronne des Tasses." The new apparatus was early seized on by experimentalists, and the first Voltaic pile made in England was that of Nicholson and Carlisle, with which they decomposed water. In the hands of Davy the electric battery led to astonishing results, but these were all surpassed when Oersted for the first time discovered the influence of an electric current passing along a conductor on a magnetic needle, and thus founded the science of electromagnetism on which nearly all later developments have been based.

LAPLACE, less fortunate than Volta, came of poor parents and owed his education to wealthier neighbours. He was born at Beaumont-en Auge, Calvados, in 1749. Having taught mathematics for a while in his native place he went to Paris, enlisted the sympathies of D'Alembert, and found an instructor's place in the military school. Thence onward his progress was such that he was soon recognised as the rival of Lagrange. His memoirs of 1784 to 1789 on the motions of the moon, Jupiter, and Saturn are amongst the most important ever written. The Revolution found him an examiner to the artillery and a prominent member of the Paris Academy of Sciences, and as such he did valuable work on the Commission of Weights and Measures. Though the academies were all suppressed in 1793, the fall of Robespierre was followed by the opening of the École Normale, the École Polytechnique, the National Institute, and the Bureau des Longitudes, in all of which Laplace took his place. His "Système du Monde" saw the light in 1796; the first part of the "Mécanique Céleste" in 1799. His famous nebular hypothesis was contained in the former. As an official he held office in 1799 as Minister of the Interior but only for six weeks, but afterwards he became a member, vice-president, and chancellor of the Senate. Under the Empire he was made a count and after the restoration a marquis. His later years were spent amid pleasant surroundings at Arceuil, where many paid homage to him. The last tributes to his memory were paid by Poissoin and Biot over his grave in Père la Chaise Cemetery, Paris, where he lay for sixty-one years. His remains were then exhumed and removed to Saint Julien de Mailloc, near his native place.

THE modern treatment of leprosy is based mainly upon improved technique in the administration of chaulmoogra and hydnocarpus oils, or rather of the sodium salts or ethyl esters of their characteristic acids. In place of administration by the mouth, the drugs are now administered by intramuscular and intravenous injection, or by subcutaneous infiltration. Moreover, treatment is now continued over long periods of time. The bacillus of leprosy is a delicate organism, which can only secure a footing in an enfeebled host deprived of his natural powers of resistance by bad environment, scanty nutrition, or coincident disease. Residence under medical supervision in a well-organised leper colony suffices only to cure a small number of cases; the modern oil treatment has greatly increased the number of cures.

THERE are, however, still a considerable number of resistant cases, notably those of patients suffering from malaria, hookworm, or syphilis, who have been made vulnerable to leprosy infection. The difficulty is that the leper is apt to react to well-known drugs quite differently from the non-leprotic patient. Thus, Dr. E. Muir, of the School of Tropical Medicine and Hygiene, Calcutta, states that it is often dangerous to administer the usual arsenical drugs, such as neosalvarsan, to a syphilitic leper; so that it has become necessary to find a drug which combines the oil treatment referred to above with the antisyphilitic treatment for such cases. Such a drug has been prepared in the Wellcome Chemical Research Laboratories in London, under the direction of Dr. T. A. Henry, and has been tested since 1924 by Dr. Muir in India. The drug is a mercury derivative of meta-hydroxybenzaldehyde, rendered soluble in hydnocarpus or chaulmoogra oil, or in the ethyl esters made

from these oils. It can therefore be injected in solution in these products, and the patient undergoes treatment for the two diseases at the same time. In the October issue of the *Indian Journal of Medical Research*, Dr. Muir gives the results of the treatment of thirty cases, all of which showed positive Wassermann reactions at the start. After treatment, sixteen became negative, two were doubtful, and only eight remained strongly positive, whilst all showed improvement so far as the concurrent leprosy was concerned. Not the least satisfactory feature of the new drug is its safety; in none of these cases did it give rise to undesirable symptoms.

ON Friday, Feb. 25, Sir Ernest Rutherford delivered the twelfth Guthrie Lecture to the Physical Society of London, assembled at the Imperial College of Science. Sir Ernest devoted the first part of his lecture to a description of the earlier work on the scattering of α-particles, which established the existence and charge of the nucleus; these experiments demonstrated that there is a wide region in the neighbourhood of the nucleus within which the inverse square law of force is obeyed, a remarkable point on which the lecturer laid stress. He then turned to the recent work on scattering carried out in the Cavendish Laboratory, in which, by the use of swift α-particles bombarding light nuclei, the law of force in the boundary regions of the nucleus itself has been investigated. Discussing the alternations of force which these experiments have established, he referred, not very hopefully, to the services which the new quantum mechanics might possibly render in elucidating the many puzzling features attending close collisions of nuclei. He concluded a fascinating lecture by describing a model of a radioactive nucleus, in which there is a nucleus within the nucleus, the inner nucleus possessing the full net positive charge, and being surrounded by circulating neutrons, *i.e.* α-particles neutralised by two electrons each. When such a neutron loses two electrons it is repelled and ejected as an α-particle. Sir Ernest appears to think that magnetic forces as well as electric forces will have to be invoked in future treatment of nuclear collisions.

IN his seventh Gifford Lecture in the University of Edinburgh, delivered on Friday, Feb. 25, on inorganic evolution, Prof. A. S. Eddington referred to the evolution of matter and of worlds as the beginning of a process which seems to reach its culminating point in the evolution of man. He reviewed the astronomical evidence bearing on the position of man in the universe—or in old-fashioned phrase, the 'plurality of worlds.' Is there reason to think that there exist other globes inhabited by beings which (however different physiologically) could be regarded as our compeers? In the solar system the two planets Mars and Venus are evidently the most eligible. Venus is swathed in thick clouds, and ideas as to what may lie beneath are entirely speculative. Mars presents a clear surface and invites more detailed study. On the important question of an atmosphere, it is now established that Mars has an atmosphere which, though thinner than our own, is probably adequate. Water is undoubtedly present, though in small amount. There are no oceans; but extensive clouds are occasionally photographed, and the white polar caps, which melt away entirely in summer, are snow deposits. Direct measurements of the surface temperature of Mars, by means of the heat-radiation from it, show that the climate is cold, but the temperature is not so low as to make life improbable. The remarkable feature is the regular seasonal change of the surface-markings. In the spring the dark markings spread greatly and encroach on the red (desert?) regions. It is not impossible that there may be some inorganic explanation, but the most natural hypothesis is that the change is due to the springing up of vegetation. If there is vegetable life, can we exclude animal life? But here the astronomer has come to the end of his facts and can take no responsibility for any further speculation. Prof. Eddington added that he does not think any weight can be attached to inferences sometimes drawn from the supposed artificiality of the so-called 'canals'; and further, it is exceedingly improbable that the zenith of evolution would happen simultaneously in two such widely different planets as Mars and the earth.

ON Mar. 1, the day preceding the delivery of the Frazer Lecture by Dr. Marett at Cambridge, Sir James and Lady Frazer entertained a number of friends at dinner in Trinity College. The presence in Cambridge of a large number of anthropologists for the purpose of attending the lecture, conferred upon the dinner a representative and official character, of which full advantage was taken to express the honour and esteem in which the author of "The Golden Bough" is held by his fellow-workers and disciples as well as by those eminent in other branches of learning. The eloquent and graceful tribute of Dr. Nairne, who proposed the health of Sir James Frazer, was followed by speeches from Lord Crawford and Balcarres, Chancellor of the University of Manchester, and Prof. E. Gardiner, formerly Vice-Chancellor of the University of London, on behalf of the universities, and by Mr. H. J. E. Peake, president of the Royal Anthropological Institute. The Rev. Edwin Smith spoke on behalf of workers in Africa, and Sir Frederick Whyte, first president of the Indian Legislative Council, represented India. The Master of Downing proposed the health of Dr. R. R. Marett as Frazer lecturer, and the latter in his reply referred to the sympathy and support given by Lady Frazer to Sir James in his work. Sir William Boyd Dawkins and Mr. E. N. Fallaize, honorary secretary of the Royal Anthropological Institute, who acted as chairman, also spoke.

A NEW quarterly periodical dealing with archæological matters is to appear shortly under the title of *Antiquity*. It will be edited by Mr. O. G. S. Crawford, Archæological Officer of the Ordnance Survey, Southampton, whose official position will serve as a

guarantee that it will be closely in touch with recent discovery in England. The articles will be written by specialists, but will be popular in character and appeal to all who are interested in the development of human origins, dealing with archæological topics and giving news of current events more fully than is possible in the daily press, but in a more general form than in the technical journals. The periodical will have a wide scope and interest. Discoveries in Egypt, Mesopotamia, Crete, the Mediterranean, India, and Palestine will be given prominence; but British archæology will receive chief attention. A special feature will be the extensive use of air photographs for the purpose of illustration. In the list of contributions already promised a wide field is covered by writers of authority, including the more prominent continental archæologists. The subscription price is £1 per annum.

WE have received copies of the November and December issues of *Rivista di Fisica, Matematica and Scienze Naturali* (Naples), these being the first numbers of the second series of this review, which was founded at Pavia in 1900 by Prof. Pietro Maffi, but came to an end in the early days of the War. A photograph reproduced in the December number of the journal shows that at the summit of Vesuvius there still exist portions of the vast abyss which was formed during the eruption of 1906 and was then about 300 metres deep but is now only 100 metres. Since the decapitation of the great cone was oblique with an inclination towards the north-east, in that quadrant the depth is barely 20 metres, so that a further flow of lava from this side may be expected. At the south-west quadrant of the crater platform there stands the small eruptive cone, which is about 60 metres high, but varies in height from day to day owing to the constant demolition and reconstruction caused by the almost continuous explosions of scoria. The filling of the abyss has been, and is still being, effected by the ashy materials emitted from the eruptive cone and by the lava extruded from time to time from radial crevices opening in the flanks of the same cone.

SIR SYDNEY CHAPMAN, permanent secretary of the Board of Trade; Sir Alexander Gibb, consulting engineer; and Sir Israel Gollancz, secretary of the British Academy, have been elected members of the Athenæum Club under Rule II., which provides for election by the Committee of "persons of distinguished eminence in science, literature, or the arts, or for public services."

A FLYING expedition to the Antarctic is being planned by Senor Antonio Pauly, who recently laid his plans before the Sociedad Argentina de Estudios Geographicos. The *Geographical Journal* for February gives some details. The main idea involves the route originally proposed by Dr. W. S. Bruce and later adopted by Sir E. H. Shackleton, of a traverse of the continent from the Weddell Sea to the Ross Sea. But the starting-point will be Wandel Island on the west coast of Graham Land, which has been chosen on account of its level surface and accessibility by sea. Here a scientific station will be established, subordinate to the main expedition. A reconnaissance by air will establish an advanced base on the coast or in the interior of Graham Land about latitude 70° S., where a petrol depot will be formed. The final flight will be made from this base, landings being made *en route* for the purpose of scientific observations. By arrangement with the whalers in the Ross Sea, it is hoped to lay down depots of provisions in McMurdo Sound. The project holds out the prospect of useful scientific results, but the flight would be a long one through unknown atmospheric conditions, and its chance of success is not enhanced by the proposal to make several landings on the way. It is not proposed to start for at least another year.

THE Ecclesiastical Commissioners have agreed to lease to the East Riding Antiquarian Society the old tithe barn at Easington, erected about A.D. 1500, and one of the few of its type still in existence, for the purpose of an 'out door' museum. In it will be exhibited the collections of obselete farming appliances of various types and the large series of objects illustrating country life now in the possession of the Hull municipal authorities. Other exhibits will accrue, no doubt, as time goes on. The provision of alternative accommodation for the present tenant and other requirements will necessitate an expenditure of £645, towards which subscriptions are asked. This appeal is one which should be supported by all who realise the importance of preserving the fast disappearing relics of the local and peasant industries of England. Donations should be sent to Mr. T. Sheppard, The Museum, Hull.

THE Electricity Bill having given its sanction to a great network for interlinking generating and distributing stations for electrical power in Great Britain, engineers are beginning to look ahead and study the problems which will have to be solved if continuity of supply is to be safeguarded. In a paper to the Institution of Electrical Engineers on Feb. 17, Mr. F. H. Clough read a paper on "The Stability of Large Power Systems," which is a question of ever-growing importance. He concludes that synchronous motors, that is, motors which run exactly in step with the generators, can be made sufficiently stable for all usual power supply purposes. It is necessary, however, to consider not only the maximum power for which the circuit has been designed, but also that which the system may have to carry momentarily if a fault develops. In America it has been found that even with 220 kilovolts between the transmission lines, quite satisfactory results have been obtained up to distances of 250 miles. When the length was increased to 400 miles the conditions for stability became apparently quite different. The problem in this case presents considerable mathematical difficulty.

FOR purposes of trans-Atlantic Telephony, the 'fifth' American zone, which comprises all places in the States of Washington, Oregon, California, Nevada, and Arizona, has now been made available. The charge for a call from any place in the fifth American zone to any place in Great Britain is £17 : 8*s.* for the first three minutes and £5 : 16*s.* for each additional minute or fraction thereof. A 'report charge' of £2 is made when a 'particular person' call cannot be effected. The whole of the United States is now in telephonic communication with the whole of Great Britain. The pioneers of this system deserve great credit for overcoming the many almost insuperable obstacles with which they were confronted, and for their patient perseverance. Research is being pushed forward with renewed vigour and we are looking forward to new developments.

MR. C. D. SHERBORN has presented to the Trustees of the British Museum (Natural History) the late Sir Richard Owen's first draft plan embodying his proposals, drawn up in 1859, for the Natural History Museum. The Department of Zoology has received from Mr. R. St. G. Burke 100 heads and skulls of Indian carnivora and ungulates, including an exceptionally fine series of Chital or spotted deer and five Sambar from the United Provinces. Dr. L. W. Sambon has presented to the same Department his collection of Linguatulida, a little-known group of parasitic animals generally regarded as being allied to the mites. Dr. Sambon's collection, which comprises 134 specimens, almost doubles the existing Museum collection of the group. The Department of Entomology has acquired some 22,000 specimens of insects, mainly Diptera, as a result of an expedition made by Mr. F. W. Edwards, a member of the staff of the Department, to north-west Patagonia. Recent donations to the Geological Department include thigh-bones of two plesiosaurs, one from the Kimeridge Clay of Dorset, the other from the Weald Clay of Sussex, from Dr. Pope Bartlett and Mr. S. Tooth respectively; and cephalopods and other molluscs from cretaceous rocks of Portuguese East Africa, presented by Dr. S. H. Haughton and Captain M. P. Traill-Smith, and from similar rocks in Great Britain by Lieut.-Colonel R. H. Cunnington. Dr. Hamshaw Thomas has given type-specimens of fossil plants (Bennettitales) from the Inferior Oolite of the Yorkshire coast. It is very satisfactory to note the increasing readiness of investigators to present to the Museum the specimens that have served as the basis of scientific work. During 1926 no less than 165 type specimens and 297 figured specimens were given by twenty workers at universities and similar institutions to the Geological Department. Indispensable as such specimens are to every serious student, their preservation is a fitting object of national concern.

IN the January number of the *National Geographic Magazine* (vol. 51, No. 1, Jan. 1927, Nat. Geog. Soc., Washington, D.C.), an account is given of the experimental work of Dr. W. H. Longley and Mr. Charles Martin on natural-colour photography under the sea, and eight illustrations—the first published—show the perfection to which they have attained. The work was carried out off the Dry Tortugas Island, the most western of the Florida Keys. A special technique was developed to hypersensitise the plates and so reduce the under-sea exposure to a twentieth of a second. This proved satisfactory in shallow water, but when it came to a depth of 15 feet a method had to be devised to supplement and intensify the light. A flash-light mechanism was therefore constructed which would float on the surface but yet be under the direct control of the submerged photographer to be guided by him and discharged as required. Two men in a dory followed the diver to maintain the necessary supply of air, but at a sufficient distance from the float to avoid any danger arising from the powerful explosions. The float was made of three pontoons supporting a dry-cell battery, the flash-light, each charge of which consisted of a pound of magnesium powder, and the white reflector. The camera used was enclosed in a brass case with a plain glass window in front of the lens. A supplementary hood was fitted above the regulation reflector, and by means of an acute-angled mirror the photographer was able to focus his instrument looking directly in front of him, a necessary measure owing to the difficulty of bending over the camera while wearing diving-dress. The photographs give a vivid impression of the wealth and variety of form and colour under the sea, those showing the colour-changes of the different fishes reacting to their surroundings being particularly fine.

AT the annual general meeting of the Optical Society, held at the Imperial College of Science, South Kensington, on Feb. 10, the following officers and members of council were appointed for the session 1927–28: *President*, Dr. R. S. Clay; *Vice-Presidents*, Mr. F. F. S. Bryson, Mr. H. H. Emsley, Mr. J. Guild, Mr. F. C. Watts; *Hon. Treasurer*, Major E. O. Henrici; *Hon. Secretaries*, Prof. A. F. C. Pollard, Imperial College of Science, South Kensington, S.W.7; Mr. W. B. Coutts, Artillery College, Woolwich, S.E.18; *Hon. Librarian*, Mr. J. H. Sutcliffe; *Editor*, Dr. J. S. Anderson; *Council*, Mr. D. Baxendall, Mr. W. M. Brett, Mr. E. F. Fincham, Mr. E. T. Hanson, Instructor Commander N. M. S. Langlands, R.N., Prof. A. O. Rankine, Mr. H. C. Raxworthy, Mr. J. Rheinberg, Dr. G. F. C. Searle Mr. W. Swaine, Mr. R. S. Whipple, Colonel H. S. L. Winterbotham.

THE ninety-fifth annual meeting of the British Medical Association will be held in Edinburgh on July 15-23. According to the provisional programme, the incoming president, Sir Robert Philip, will deliver his address on Tuesday, July 19, at 8 P.M. Throughout the meeting the annual exhibition of surgical appliances, foods, drugs, and books will be open for inspection. The honorary local general secretary of the annual meeting is Dr. A. Fergus Hewat, 14 Chester Street, Edinburgh. A Lister Centenary Celebration is also being arranged at Edinburgh in July in connexion with the meeting. Throughout the week, a museum of Lister relics will be on view in the Upper Library of the Old University.

On July 20 a public meeting will be held, presided over by Lord Balfour, and Sir Watson Cheyne, Prof. T. Tuffier (Paris), Prof. Harvey Cushing (Harvard University), and Prof. James Stewart (Dalhousie University, Halifax, Nova Scotia) will deliver addresses. Inscriptions are to be placed on the walls of 11 Rutland Street and 9 Charlotte Square, both of which were occupied by Lister while in Edinburgh, and a prize of £25 and a gold medal is offered for an essay on "The Influence of Lister on Surgery," the competition being limited to first-year students of medical schools of the British Empire. A Lister memorial volume, edited by Dr. Logan Turner, is in preparation; in addition to personal reminiscences of Lister, it will contain chapters on surgery before and after Lister by Mr. Alexander Miles and Prof. Fraser respectively, while Sir E. Sharpey-Schafer will deal with Lister's work as a physiologist.

A USEFUL catalogue (No. 148) of books on gardening and botany has just been circulated by Messrs. Dulau and Co., Ltd., 34 Margaret Street, W.1. It gives the titles of nearly 900 works classified under appropriate headings and should be of service to many readers of NATURE. It will be sent free of charge to any applicant.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant chemist at the Fruit and Vegetable Preservation Research Station of the University of Bristol, Campden, Gloucestershire—The Resident Director, University of Bristol Research Station, Campden, Gloucestershire (Mar. 14). A keeper of the Birmingham City Museum and Art Gallery—The Town Clerk, Birmingham (Mar. 19). A director of research under the British Cotton Industry Research Association—The Secretary, British Cotton Industry Research Association, Shirley Institute, Didsbury, Manchester (Mar. 21). A headmaster of the R.N. College, Dartmouth—The Secretary, C.E. Branch, Admiralty, S.W.1 (Mar. 21). Chemical assistants in the public health department of the L.C.C.—The Clerk of the L.C.C., County Hall, Westminster Bridge, S.E.1 (Mar. 25). A director of research into the prevention of water pollution and cognate problems—The Secretary, The Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (Mar. 31). A lecturer in advanced and economic entomology in the University of Cambridge—The Registrary, University, Cambridge (May 31). A chemist and metallurgist in the Egyptian Government Assay Office, Cairo—The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1. An entomologist under the Sierra Leone Government, principally for tsetse fly investigation work—The Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1. A junior assistant in the physics department of the Experimental Station, Porton, Wilts — The Commandant, Experimental Station, Porton, Wilts.

Our Astronomical Column.

BRILLIANT FIREBALL ON FEB. 25.—Mr. W. F. Denning writes: "This object appeared at 11.54 P.M. and caused a vivid illumination of the sky over the south-west of England. There was a double outburst resulting in two flashes of dazzling intensity. Some observers thought the size of the nucleus about equal to that of the full moon, but considered the luminous effect greater than that of the moon coming suddenly from behind dark clouds. The light was white, similar to that of magnesium. The flight was slow, and perhaps occupied 3 seconds in traversing 20°. A considerable number of descriptions are coming in from various places, but for scientific purposes very few are of use. Before the path of the body can be ascertained, more data must be awaited. There is a strong probability, however, that the meteor was directed from a radiant point in Leo and that it passed over the south-east region of Devonshire, falling from 66 miles to 26 miles in height at a velocity of 18 miles per second. Several large fireballs have been directed from this radiant (near Regulus) at the end of February in past years."

SOLAR RADIATION.—In *Memoirs of the Imperial Marine Observatory*, Kobe, vol. 3, No. 1, R. Sekiguti gives the results of an investigation undertaken by him for the purpose of detecting a possible direct effect of the sun's activity on air temperatures. The Greenwich daily sunspot areas are correlated with daily temperature rises observed for a standard type of weather. The meteorological data were collected from five stations in the plateau district of central Japan, and a selection was made from the years 1905–13 according to certain criteria of cloudiness, wind velocity, etc. The general conclusion advanced by the author is that there is an indication that small temperature rises occur with an inactive solar surface, and that moderate sunspot activity is responded to by high temperature rises. This conclusion is stated with diffidence, and the scantiness of the meteorological data and the difficulties of dealing with air temperatures for this purpose are frankly admitted.

THE SUN'S MOTION DERIVED FROM FAINT STARS.—Perplexity has frequently been caused by the wide discordances between the positions of the solar apex when derived from stars of different magnitudes. These have in some cases been traced to systematic errors in the adopted proper motions. Mr. P. van de Kamp (*Bull. Astron. Instit. Netherlands*, vol. 3, No. 112) gives a new determination, based (1) on the photographically determined proper motions of 1900 tenth magnitude stars, uniformly distributed, but all north of declination − 30°; (2) from the radial velocities of 105 stars of magnitudes 9-10 within 50° of the solar apex or antapex. The combined result for visual magnitude $10^{m}\cdot1$ gives for the apex, R.A. 277°±3°; Decl. 38°±3°, if Raymond's corrections are applied to Boss's proper motions in decl., or 31°±3° if van Rhyn's further corrections are applied; solar velocity 18±2·2 km./sec. for visual magnitude 9·2. These results are in fair accord with W. W. Campbell's values derived from the radial velocities of 2034 stars brighter than 5·5, namely, R.A. 268°·9±2·2, Decl. +27°·2±1°·7, Vel. 19·0± 0·6 km./sec.

Research Items.

Prehistoric Cultures of Siberia. — While certain parts of Central Asia and Mongolia have recently attracted the attention of anthropologists and archæologists, the neighbouring country of Siberia remains scarcely explored in this respect. This consideration induced the State Russian Museum (formerly the Museum of Alexander III.) in Leningrad to send a palæ-ethnological expedition to the Altai mountains during 1924-1925. The expedition, under the leadership of Prof. S. J. Rudenko, explored in a systematic way a very large part of the country, and the results of the numerous excavations made indicate that the cultural life of the country was very intensive. The earliest remnants found belong to the later phase of the stone age; the skeletons found were brightly painted with ochre. About twenty places, with remnants of the bronze age, have been explored, and numerous articles, ornaments, and implements found. Some rather more recent stone graves discovered on the River Tchulishman contained, amongst other things, ornaments plainly indicating some connexion between the Altai nomads of those days and the Byzantinian culture.

The Indians of Huaxtec.—The recently published vol. 18 of the *Journal de la Société des Américanistes de Paris*, contains a study by Dr. Waltier Staub of the area known to the Aztecs as *Cuextlan* (Shores of the Salt Water), and to-day known as Huaxtec—land on the eastern side of the Mexican plateau, bordering on the steppe country of the north in which the culture of the nomad tribes contrasts with that of the settled agriculturists of the low-lying lands below. The special interest of this area from the ethnological point of view is that the inhabitants would appear to be an early offshoot of the Maya. At the time of their first settlement they would appear, judging from certain clay figures found in the alluvium of the Rio Panuco, to have been already acquainted with weaving and pottery-making. On the other hand, the absence of stone temples, of hieroglyphs, or any system of writing, indicates a fission before the Maya were acquainted with the calendar or had developed their system of writing. According to Lehmann and Sapper, the dialect which most closely resembles the Huaxtec of to-day is the Chicomucelotec of the frontier of Chiapas-Guatemala, their separation being due to an incursion of Totonacs and Olmecs towards the Atlantic coast. The geographical position of the Huaxtec country, borderings on the steppe lands, made it more suitable for hunting and fishing than agriculture, and it was thus left free from the intrusion of other peoples; while it was never occupied by the Aztecs, although it paid tribute to them. The inhabitants were thus able to preserve their culture and their language unaffected. The Huaxtecs of to-day are still extremely primitive, living in hamlets in bamboo circular huts, often without chairs or tables. They sleep on the ground and do not use the hammock. The principal deity of the pre-Columbian Huaxtecs was the earth goddess, and until recent years sculptured representations of her were frequently to be found on the hills, but of these many have now been removed for sale.

Nematode Eggs from Skin and Gills of Shark.—G. A. MacCallum records (*Proc. U.S. Nat. Mus.*, Vol. 67, Art. 16, 1925) the occurrence of the eggs of a nematode, probably a species of Capillaria, on the under surface of the nose, in front of the mouth, of a large shark, *Carcharinus commersoni*, taken near Woods Hole. The dark brown, almost black, eggs were laid in the groves between the scales and attached by transparent adhesive material. Similar eggs were found on the lighter coloured portions of the fins of another shark of the same species. In a later paper (vol. 70, Art. 6, 1926) the same author records eggs, tentatively referred to the genus Capillaria, on the gill arches of *Carcharinus milberti* at Woods Hole. These eggs are in patches, sometimes two inches long by half an inch wide, and the egg shell is spinous. In neither case were adult worms found which could have laid the eggs.

Creeping Eruption in America.—A short note in the *Official Record of the U.S. Dept. of Agriculture*, vol. 5, No. 43, Oct. 1926, summarises the recent work on creeping eruption in man by J. L. Kirby-Smith, W. E. Dove, and G. F. White (see *Arch. Dermatology*, 13, 1926, pp. 137-173). The eruption is caused by a nematode larva. During a further study, Messrs. Dove and White have recovered infective nematode larvæ from the fæces of the dog and the cat in a locality where there was a high incidence of creeping eruption. The larvæ were applied to the human skin and produced the characteristic symptoms and lesions. These larvæ have "in general the appearance of hookworm larvæ." In 26 out of 27 dogs from the streets of Jacksonville and in both of two cats, Ancylostoma were found and two species identified as *A. braziliense* and *A. caninum*. The authors state that further work is in progress. Creeping eruption occurs chiefly in the South Atlantic and Gulf States, but it has been reported so far north as New Jersey and inland so far north as Oklahoma. Damp sand in these areas has been observed to be a favourable environment for the parasite and a likely location for infection.

Medusæ of the Danish Ingolf-Expedition.—Dr. P. L. Kramp, of the Copenhagen Zoological Museum, gives a most interesting account of the Anthomedusæ of the Danish Ingolf-Expedition (vol. v. 10, Medusæ, Part 2, Copenhagen, 1926). This work follows the same plan that was used in the Leptomedusæ (Kramp, 1919) of the same expedition, the main study being the horizontal and vertical distribution, seasonal occurrence and dependence on the various hydrographical conditions. Whilst keeping these points in view, however, the author is able to show a great deal that is new with regard to the comparative morphology of many of the species, especially of those belonging to the Codonidæ. Such points as the structure of the manubrium, morphology of the tentacles and their basal bulbs, and the abaxial spurs are dealt with in detail and show important features useful in classification. *Sarsia tubulosa*, that common and much-discussed species, or group of species, is fully investigated, the conclusion being that most of the closely related forms such as *S. decipiens*, *S. pulchella*, and *S. mirabilis* are merely local varieties. An interesting point is shown in the fact that the farther north it is found the more the time of occurrence of this medusa is delayed, the liberation from the hydroid taking place later in the colder regions. That the farther north we go the later the medusa is budded off seems to be a general principle for these northern forms. The author places *S. flammia* in the genus Euphysa, having found therein certain muscular bands which probably do not exist in Sarsia. *Corymorpha nana* is the hydroid of *Euphysa aurata*, the latter probably being a separate species from *E. mediterranea*. Interesting facts are noted amongst those proliferating medusæ *Lizzia blondina*, *Rathkea*

octopunctata, and *Hybocodon prolifer*. In the first species, apparently all the young specimens normally bud and later on each one becomes sexually mature, whereas in the other two the first budding generations probably never become sexually mature. The budding of Rathkea in one and the same area is dependent on the water temperature, being accelerated and ceasing earlier when the water is warm than when it is cold.

THE BIOLOGY OF THE SAW-TOOTHED GRAIN BEETLE.—In the *Journal of Agricultural Research*, vol. 33, No. 5, 1926, Messrs. E. A. Back and R. T. Cotton record a number of interesting observations on the biology of this cosmopolitan insect. Although it may occur in almost any stored food of vegetable origin, and has been known for more than 150 years, the life-cycle of *Oryzœcephalus surinamensis* Linn. has received but little attention from entomologists; even Redi in 1671 figured an insect which is very possibly this same species. Linné received specimens from Surinam, and for that reason gave it the specific name by which it is known. A remarkable fact brought to light by Messrs. Back and Cotton is the longevity exhibited by the adult beetle. Under laboratory conditions, male individuals lived more than two years, and one example survived for three years and three months. The females appear to be shorter lived; few lived longer than one year, but one example survived for two years and eight months, laying 216 eggs during that period. Under the most favourable weather conditions, the whole life-cycle may be passed through in 27 days. On the other hand, low temperature may prolong the period to 315 days. At Washington, D.C., there are four or five generations annually, but in the tropics there are doubtlessly more. It is interesting to note that a temperature of 0° to 5° F. for one day will kill all stages, and if the temperature be raised to 125° F. all stages succumb within an hour. A vacuum of 29 in., continued for seven hours, killed the adult insects.

THE LANDFALL OF COLUMBUS.—In a paper read before the Royal Geographical Society on Feb. 14, Lieut.-Commander R. T. Gould returns to the much-debated question of which island in the Bahama group Columbus first sighted. Since the original journal of Columbus is lost, the available evidence is circumstantial and indirect, and at best can indicate only the most probable island. At the outset Commander Gould dismisses, as unsupported by any evidence, the suggestion that volcanic disturbances or changes in sea-level may have altered the appearance and distribution of the islands since Columbus's voyages. The island which Columbus named San Salvador was clearly one of the Bahamas and has been variously identified with Cat, Grand Turk, Watling, Mariguana, and Samana Islands. Commander Gould discusses in turn the grounds for each identification in the light of the evidence available. This falls under several heads: (1) Courses and distances sailed by Columbus between his departure from Gomera in the Canaries and Guanahani, the native name of his landfall, for which the material is very scanty; (2) evidence from the small-scale chart of Cosa (1500) or the chart of Herrara (1601); (3) comparison of Columbus's description of Guanahani with the various likely islands as they exist to-day; (4) plotting on a modern chart the relative bearings and distances of the islands discovered by Columbus. The result of each line of researches leads Commander Gould to the same conclusion, that Columbus's landfall was Watling Island, now also known as San Salvador.

MINERAL DEPOSITS IN RUSSIA.—Results of current research in mineralogy in Russia are being published mainly by the Institute of Applied Mineralogy and Metallurgy in Moscow, and by the Geological Committee of Leningrad. The Moscow Institute published during 1926 some ten papers of considerable practical and theoretical interest, including the results of original investigations on the chemistry of minerals by Ginsberg, and on kaolin and other deposits in the Urals. An outstanding work is that by V. A. Obrutchev on "Metallogenetic Periods and Regions of Siberia"; the author finds six separate metallogenetic periods in Siberia; Archean (numerous deposits of gold, and several of iron, silver, lead, and molybdenum); Eozoan (still more gold, some copper, iron, and tungsten); Caledonian (little gold; deposits of copper, silver, lead, zinc, and tungsten also not numerous); Hercynian (gold deposits rare, but those of polymetallic ores numerous; some tin, tungsten, and mercury); Tian-Shanian (polymetallic ores prevalent; nickel, platinum, copper ores); Meso-Neozoan (gold, copper, silver, lead, zinc, iron, bismuth). A geo-morphological survey of Siberia is given by the author and important bibliography appended. In the series of publications by the Leningrad Geological Committee there is an interesting report by A. D. Natsky on the sulphur deposits in the Karakum desert of Turkestan; M. M. Tetaiev gives a classification of Russian tungsten ores, and A. K. Meissner presents an almost monographic description of gold deposits of Russia.

DEVONIAN FLORA.—The most important contribution to Devonian palæobotany since the discovery of the Rhynie fossils is described by Dr. Dukinfield Henry Scott in the *New Phytologist* (vol. 25, No. 5). The new specimens, which came from several localities near Elberfeld and belong to the lowest division of the upper Middle Devonian, have been investigated by Drs. Kräusel and Weyland (*Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft*, Bd. 40, Heft 2, 1926). So far they have described the following five plants: *Asteroxylon elberfeldense* n.sp., *Aneurophyton germanicum* K. and W., *Hyenia elegans* n.sp., *Calamophyton primœvum* n.gen. et sp., *Cladoxylon scoparium* n.sp. There is a far-reaching agreement between the Elberfeld and the Rhynie Asteroxylon. They differ, however, in the presence of pith in the German form, in the stellate form of stele, and in the occurrence of pitted tracheids. Aneurophyton was probably a tree with the habit of a tree-fern, and its frond structure may throw some light on the question of the origin of the fern-like frond. The chief point of interest in regard to *Hyenia elegans* is the presence of the fructification, previously unknown in the genus, and taking the form of loose spikes with numerous forked sporangiophores arranged on the axis. On account of the dichotomous branching, *H. elegans* and *Calamophyton primœvum* are relegated to two distinct series of a new class, the Proto-articulatæ, although, in view of the close agreement in the structures of their fructifications, there seems some reason for including them in one series. The last species, *Cladoxylon scoparium*, is an unexpected find in the Middle Devonian, and the external habit and the fructification, hitherto unknown, have now for the first time been revealed. "The discovery of this Middle Devonian species must reopen the disputed question of the Upper Devonian or Lower Carboniferous age of the Saalfield Cladoxylons."

THE SPECTRUM OF ARGON.—A few years ago, F. Paschen succeeded in analysing the complicated line spectrum of neon. A similar analysis has now been effected for the 'red' spectrum of the next inert gas, argon. In two recent papers (*Zeits. f. Phys.*, 39, p. 172, and 40, p. 839) K. W. Meissner has shown

that this, too, can be derived from four sets of s-terms, ten of p-terms, and twelve of d-terms. Most of the wave-numbers are from his own measurements, but some lines observed by other workers in the ultra-violet fall into the same scheme. An interesting consequence has been pointed out by W. Grotrian (*idem*, 40, p. 10). The screening effect of the inner electrons for the X-ray $M_{21}M_{22}$ doublet in the heavy elements, in which the M shell of electrons is complete, is such as to reduce the effective nuclear charge by 8·5. Meissner's analysis shows that the screening constant is 7·3 for argon, where only the first eight electrons of the M shell are present; for the next element, chlorine, its value is 7·5.

STRUCTURE OF THE MOLECULE OF CARBON MONOXIDE.—Recently spectroscopists have been able to show, from the analysis of some carbon band spectra, that the outer electrons in an excited carbon monoxide molecule have energies which fall into a scheme very similar to that for an atom of the second group of the periodic table. This analogy has now been extended by F. L. Mohler and P. D. Foote (*Phys. Rev.*, 29, p. 141, 1927). By the 'partial current' method for measuring excitation potentials, the effect of inelastic collisions of an electron with gas molecules is shown by the change in the electron current to a collecting electrode as the energy of the electrons is varied. When such experiments are made with carbon monoxide and mercury vapour under comparable conditions, the current–voltage curves obtained exhibit an astonishing similarity. The form of the curves yields information about the relative probability of occurrence of the possible quantum transitions, and it is concluded that not only the energy levels, but also the movement of a valence electron from one to another of them, are alike in the respective molecules and atoms.

THE PYCNOSONDE.—A new instrument for measuring the specific gravity of sea water, invented by Dr. D. la Cour of the Danish Meteorological Institute, is described in the *Marine Observer* for March. It consists of a glass tube bent twice at right angles and fixed on a metal frame for protection. One branch of the tube is narrow and the other wide. The narrow end is open and the wide end is closed by a water-tight valve opening inwards. As the tube is lowered in the sea the increasing pressure slowly forces water in through both ends and the air is compressed in the upper part of the wide arm. When the instrument is hauled up the valve keeps closed as the pressure decreases, and the expanding air escapes by the narrow arm. When the surface is reached the wide arm contains a complete sample of the various waters through which the instrument has passed, arranged in the proper order. In the wide arm, before lowering, are arranged small coloured glass floats—pycnodevils—of certain specific gravities. They assume positions in the column of water corresponding to certain definite values. Thus when the pycnosonde is brought out of the water the pycnodevils have arranged themselves at different heights, and the depths to which these heights refer can be readily determined by a suitable scale. It has been found in practice that there is no appreciable mixing of the layers of water in the tube even when the temperature of the whole instrument is altered. It is claimed that in shallow water this instrument works well, and can be used from a moving vessel with the Kelvin sounding machine.

MICROMAGNETIC OSCILLATIONS AT ZOUY. — In *Terrestrial Magnetism* for September 1926, Arnold Pödder, of the Meteorological and Magnetic Observatory at Zouy (formerly Irkutsk), Russia, discusses the micromagnetic oscillations observed there by sensitive magnetographs. Two very different types of these waves are found to exist; in one the vibrations continue very regularly for hours or even days, with well-defined periods of from 5 to 15 seconds. In the other type the vibrations, though less regular, have a pronounced periodical character, the periods being considerably longer, however, with an average value of about 35 seconds. A year's observations are discussed, relating to all three magnetic elements; the vertical force observations were made both by a balanced magnet and by a horizontal coil. In the short-period oscillations the intensity increases with the period (from about 0·5 γ for 5 seconds period to about 2·5 γ for 15 seconds period—the intensity being nearly the same in the horizontal and vertical components); 90 per cent. of these vibrations have periods between 7 seconds and 9 seconds. They occur particularly between midday and 7 P.M. local time, while at night the longer periods are more prominent. No hypothesis is advanced as to the cause of the vibrations, but certain similarities to microseismic waves are pointed out.

FORMATION OF AMMONIA IN THE SILENT DISCHARGE. —Warburg and Rump (*Zeit. für Phys.*, vol. 40, p. 557, 1926) have recently studied the formation of ammonia in the silent discharge and have compared the results with those obtained in the production of ozone by the same method. A mixture of nitrogen and hydrogen was passed so quickly through a Siemens' tube that the amount of ammonia formed was so small that any decomposition could be neglected. It was found that the ammonia was formed chiefly at the walls, whilst the ozone is formed chiefly in the interior of the discharge tube, probably because of the greater heat of dissociation of nitrogen and the catalytic action of the surface of the tube. Variation of pressure produced very much less effect in the case of the production of ammonia than in the case of ozone, presumably because the number of ionic collisions at the walls was very small compared to the number in the interior of the gas.

CHARACTERISATION OF GENUINE PROTEINS.—The Hugo Müller Lecture, which was delivered before the Chemical Society by Prof. S. P. L. Sörensen on Oct. 28, 1926, has been published in the Society's *Journal* for Dec. 1926, and it gives an account of some of the diverse problems which, at the present moment, occupy the attention of those engaged in a study of the composition of the proteins. These problems are of two kinds: the first deals with the nature of the simpler compounds from which the protein molecules are built up, while the second is concerned with their 'elementary' composition. The decomposition products which can be obtained by treating the proteins with acids, alkalies, or suitable enzymes, form the most important clue as to protein structures, and about twenty such substances are now known. It is considered that protein molecules consist of a number of loosely knit polypeptide complexes, and this view accounts for the remarkable properties that the proteins possess. With regard to their elementary composition, it is well known that all protein substances contain carbon, hydrogen, oxygen, and nitrogen, and most of them also small quantities of sulphur and phosphorus. Since the sulphur and phosphorus contents are small, it has been suggested that the sulphur- or phosphorus-containing compounds are only loosely associated with the protein molecules, and are not integral constituents of them. Careful fractionation has shown that this is true of the serum proteins, but the phosphorus in egg albumen appears to be intimately bound up with the rest of the molecular complex.

The Genetics of Wheat Species.

RECENT years have witnessed important advances in our knowledge of the wheats, which are now recognised to fall into three well-marked groups, differing in their chromosome numbers and rust resistance, and showing inter-sterility when members of different groups are crossed. Much genetical work has been devoted, not only to crosses between hexaploid and tetraploid or tetraploid and diploid species, but also to crosses between species having the same chromosome numbers. In the latter series of crosses, in which there is relatively full fertility, various investigators, including Tschermak, Nilsson-Ehle, Engeldow, Percival, Kajanus, and Malinowski, have taken part. The results of these crosses between wheat species having the same chromosome numbers have been much simpler than might have been anticipated, and they raise some interesting questions concerning the relationships between these species, the nature of the differences involved, and the manner in which these differences are germinally represented.

Some of these questions are discussed in a recent paper by Prof. E. Malinowski (*Jour. of Genetics*, vol. 17, No. 2), in which he propounds the view that the phenomena can be explained by assuming linkages between different pairs of chromosomes. Such linkages would resemble in some respects those which are known to occur between many of the chromosomes of Oenothera species. Such connexions between chromosomes have not yet been described as regular occurrences in the wheats, although much cytological work has been done on this group, and there are other difficulties with the hypothesis proposed, which, nevertheless, will doubtless lead to a further analysis of the differences between species of wheats.

In 1914, Malinowski found that a cross between the two hexaploid wheats, *Triticum Spelta* and *T. vulgare* (each with 42 chromosomes), gave an intermediate F_1 and an F_2 which contained *T. Spelta*, the intermediate type, and *T. vulgare* in the ratio 1 : 2 : 1, although an independent factor for *T. compactum* (club wheat) was also present. Kajanus confirmed the 1 : 2 : 1 result. Now *T. Spelta* has longer ears than *T. vulgare*, and its glumes and spikelets also have a different shape. Hence, in spite of the monohybrid behaviour, it appears probable that a number of (linked) genetic differences are involved. Whether it is necessary to assume that these factors reside in independent chromosomes which have become linked, as Malinowski suggests, remains to be seen.

In crosses between *T. polonicum* and *T. dicoccum*, both tetraploid species with 28 chromosomes, the same 1 : 2 : 1 ratio is obtained in F_2, although here again an independent factor for long or short glumes may be present. The same ratio obtains when *T. polonicum* is crossed with *T. durum*, another tetraploid species.

When a tetraploid is crossed with a hexaploid wheat, the results are much more complicated. For example, in *T. polonicum* × *T. vulgare* the F_1 pentaploid hybrid is intermediate, but the F_2 segregates into a great variety of types, including *T. dicoccum*, *T. durum*, and *T. polonicum* (4*n* chromosomes), as well as *T. Spelta* and *T. Vulgare* (6*n*). Some of the F_3 families show segregation between two species in a 1 : 2 : 1 ratio. But they are always both tetraploid or both hexaploid species, *i.e.* they might be *durum* and *polonicum*, or *dicoccum* and *polonicum*, or *vulgare* and *Spelta*. The least complicated segregation between forms having different chromosome numbers is in crosses between *T. dicoccum* and *T. Spelta*. This yields in F_2 *dicoccum*, *Spelta*, and two other types which resemble these respectively.

In his explanatory hypothesis Malinowski assumes that the tetraploid wheats have two linked chromosomes, while the hexaploid forms have three, and that certain of these linked chromosomes are common to different species, *e.g.*, *T. dicoccum* having *a* and *c* linked, while *T. Spelta* has *a*, *c*, and *e* linked. As it seems probable that the hexaploid wheats have arisen at some time through a doubling of the chromosomes in a sterile hybrid between a diploid and a tetraploid species, the tetraploid and hexaploid wheats might be expected to have certain chromosomes in common. Whatever the explanation, these apparent linkage phenomena in wheat species are of much interest, and their elucidation may well mark another step in the advance of genetic theory.

Tschermak and Bleier (*Ber. Deut. Bot. Gesells.*, vol. 44, p. 110) have recently obtained a constant fertile octoploid hybrid by crossing *Aegilops ovata* with *Triticum dicoccoides* and *T. durum*. This they believe supports Percival's hypothesis that the hexaploid wheats arose from crosses of *T. dicoccoides* with Aegilops. But Percival (*Jour. Genetics*, vol. 17, p. 60) has found that Aegilops itself contains species with 2*n*, 4*n*, and 6*n* chromosomes.

Another set of results bearing closely on these problems is derived from the work of Prof. G. C. Meister with his wheat-rye hybrids (*Saratov Agr. Exp. Station*, 1, p. 220, 1923). Six generations have been grown from the original natural crosses and a multitude of forms has been obtained, but the 'F_2' consisted of uncontrolled back-crosses with the parents. The parent wheat was hexaploid and the rye diploid, the hybrid F_1 being tetraploid. Chromosome studies combined with genetical examination of the later generations should make possible an analysis of what is happening—whether merely recombination of factors already present or whether germinal changes of various possible kinds are responsible for the appearance of some of the new types. How, from a single species of wheat when crossed with rye, a whole series of wheat species and varieties, some of which are already well known, should arise, is not at present clear; but the elucidation of this problem should add much to our understanding of the relationship between different species of wheat. One of the forms thus obtained is very similar to *T. persicum*, a tetraploid wheat. A full study of the chromosomes in these hybrids may be expected to throw light on the relation between crossing and mutation, and also on the relationships between wheat species. R. RUGGLES GATES.

The Recolonisation of Krakatau by Animal Life.

THE gradual recolonising of the island of Krakatau with plants and animals subsequent to the catastrophe of 1883 is a subject of great biological interest. Dr. K. W. Dammerman, of the Buitenzorg Museum, tells us that after studying the new fauna of Krakatau it was desirable to compare it with that of some similar neighbouring island which had remained unaffected by volcanic convulsions. After taking various islands into consideration, the nearest suitable *terraine* for such comparison appeared to be Durian—a member of the Rhio-Lingga archipelago. It has about the same area as Krakatau and is situated between the bigger island of Sumatra and the Malay Peninsula (just as Krakatau lies between Java and Sumatra). The whole island is clothed with virgin forest, it has been little interfered with by man, and,

for a very long time, no volcanic eruptions have devastated its fauna and flora. The fauna of Durian proved somewhat disappointing, owing to the poor soil and the resulting rather scanty vegetation. No Ficus of any kind, for example, was detected on the island, and, it may be added, trees of the fig tribe are one of the most attractive for birds, insects, and other animals.

Dr. Dammerman states that the research on the fauna of Durian [1] was wholly planned for the purpose of comparing it with that of Krakatau—to ascertain what Krakatau's fauna possibly was before the eruption, and what it is likely to consist of in future. Taking the whole fauna into consideration, he finds that the total number of species of animals on Krakatau at present is about 62 per cent. of that of Durian, but, with regard to individual groups, very different figures reveal themselves. As regards the vertebrates, Krakatau is far behind Durian with 47 per cent., but considering terrestrial forms alone, and excluding birds and bats, Krakatau has only 21 per cent. of the forms inhabiting Durian. With the invertebrates the poorness of Durian Island is noticeable, as Krakatau already has 93 per cent. of the number of invertebrates of Durian. Of insects only, Durian has a great majority, having about 40 per cent. more than Krakatau.

The remarkable conclusion of Dr. Dammerman's comparison is that Krakatau has regained about 60 per cent. of its normal fauna after a lapse of about forty years, on the supposition that the fauna of Durian is a normal one for the comparison. He maintains that the fauna of Krakatau will be complete, not after centuries, but within a comparatively short time, much shorter than might reasonably have been anticipated. The fauna is likely to become much richer than that of Durian to-day, on account of its more fertile soil and luxuriant vegetation.

[1] K. W. Dammerman, "The Fauna of Durian and the Rhio-Lingga Archipelago." *Treubia*, vol. 8, liv. 3-4, July 1926, pp. 281-326.

Excluding bats, of which certainly many more species will reach Krakatau in future years, nine terrestrial mammals occur on Durian against only one on Krakatau. This species, the common Malay house rat, seems to have come in about 1917, but when the island was revisited in 1924 it appeared to be on the verge of extinction. This conclusion is in accordance with the theory that house rats are unable to thrive away from human dwellings. The field rat, and possibly other species, are to be expected together with the Malay macaque and the commoner kinds of wild hogs. Of the birds, it is anticipated that the fauna will become about twice as rich as it is nowadays, but fresh water being absent on Krakatau, such birds as are dependent thereon will have no chance of survival should they arrive on the island. Among the reptiles, the lacertilian *Lygosoma atrocostatum* is now abundant, whereas in 1921 the species is stated certainly not to have been there, and the same applies to the crocodile. Among the insects, Hymenoptera are not anticipated to show rapid increase of species in the future, but Coleoptera and Lepidoptera are still far from their maxima.

In short, it appears that on new land, carnivorous animals are later invaders than vegetable feeders, and on Krakatau there are as yet no insectivorous bats or other carnivorous mammals, Cicindelidæ, or predaceous flies. Other groups of raptorial insects such as Mantidæ and Neuroptera are rare. The exception appears to be the spiders, which are unusually abundant. This is explained on the basis of the extraordinary ease by which Araneæ are spread, and the fact that they thrive largely on flying insects, which are those which would reach the island early in the process of repopulation.

It is noteworthy that three species of Oligochæta (against two species on Durian) have reached Krakatau, but, as might be expected, there are no freshwater Crustacea or Mollusca, but land members of the two latter groups are represented by three and six species respectively.

A. D. IMMS.

British Industries Fair.

THE British Industries Fair, which is organised annually by the Department of Overseas Trade, was held on Feb. 21-Mar. 4 at the White City, London. A section of the Fair was held at the same time at Birmingham, mainly for hardware and engineering exhibits. Evidence of the increasing popularity of the London fair was provided by the Department being able to issue a detailed catalogue six weeks before the opening, all the exhibiting space available having been reserved by that date.

The dominating exhibit of the chemical section was arranged by the Imperial Chemical Industries, Ltd., the combine recently formed by Brunner, Mond and Co., Ltd., Nobel Industries, Ltd., the United Alkali, Ltd., and the British Dyestuff Corporation, Ltd. The exhibit was designed to show the wide range of products obtained from raw materials in general use, such as sulphur, coal, brine, and limestone. Nitram, Ltd., a subsidiary company, demonstrated in an interesting way the new principle in use for fertilising grazing land.

Another exhibit of chemical interest was the new fresco medium (silicon ester fresco) which by offering the artist a new medium may revive an ancient art some of the secrets of which have been lost. Silicon ester is said to form as convenient a medium as oil, and to combine the fluidity and facility of water colour with the strength and depth of oil. It is hoped that this discovery will lead to a revival of large mural decorations. The firm interested in silicon ester fresco—Messrs. Albright and Wilson, of Oldbury—are also promoting the use of silicon ester for consolidating and protecting the surface of decaying stone and for imparting a new siliceous face to terra-cotta in the early stages of decay. The silica is deposited in an adhesive and non-crystalline form. Remarkable success has been obtained in the restoration of decayed stone-work in old buildings by the use of this material.

Improvements in the reproduction of sound by gramophone were shown by Messrs. C. Gilbert and Co.—a Sheffield firm—who demonstrated their tone reflector, an instrument for producing great volume of sound without distortion. Among the radio exhibits the Priory loud speaker made by a Newport Pagnell firm deserves a word of commendation.

Several firms exhibited aids for the deaf. The National Institute for the Deaf has strongly advised sufferers to consult an ear specialist to ascertain whether the deafness is of a type likely to be helped by an artificial aid and to deal only with a firm willing to allow a home trial of two or three weeks before purchase. This warning is without doubt necessary, and should be widely advertised to prevent the exploitation of sufferers. Good progress is being made in electrical aids, but older forms of aid are also receiving attention. Mr. Geo. W. King, proprietor of the British Acoustic Co., himself a sufferer, showed

some light and comfortable pairs of horns, the use of which by deaf people will probably become more general in future.

Another exhibit of medical interest was the "Magic Blanket," produced by the Radiocoil Electromagnetic Blanket, Ltd., of Manchester Street, London, W.1. This blanket has more than 12,000 feet of specially prepared wire covered with downy material, the inner surface being thickly quilted. Its use is recommended by the makers for sufferers from various diseases. An induction pad is also provided to be used in conjunction with the blanket. This pad gives a rise of temperature in the blanket from 50° to 130° F. in sixty minutes, and profuse perspiration is obtained in forty-five minutes.

The Linguaphone Institute exhibited gramophone records for learning foreign languages. These records reproduce the speech of well-known elocutionists in various languages. The advantages of this simple method of learning foreign languages are obvious, and it is not surprising to learn that the records are used by more than 900 schools, colleges, and universities.

These few notes by no means exhaust the exhibits of scientific interest. The catalogue shows in the section of "Chemical and Allied Products" that a large number of British firms are engaged in the production of chemicals, drugs, dyes, fertilisers, insecticides, perfumes, and photographic materials. Makers of scientific and optical instruments are also well represented.

The Fair was visited by the King and Queen, and attracted a large number of buyers and other visitors.

University and Educational Intelligence.

CAMBRIDGE.—Mr. Ramsay, Master of Magdalene College, and Mr. Thirkill, Clare College, have been elected members of the Council of the Senate. Prof. W. J. Dakin, of the University of Liverpool, has been nominated to use the University table at Naples next April, and Mr. J. Gray, King's College, to use the University table at the laboratory of the Marine Biological Association at Plymouth next July.

EDINBURGH.—At the meeting of the University Court on Monday, Feb. 21, Dr. R. J. Clark was appointed lecturer, and Carnegie teaching fellow, in the Department of Natural Philosophy.

It was announced that Mr. Thomas Cowan had offered a sum of £15,000, supplementary to previous gifts, in order to enable the University to carry out a projected scheme for providing a residential house for men-students. Mr. Cowan has already given £15,000 to the University, £10,000 of which was contributed in appreciation of the work done by students during the general strike of 1926.

LONDON.—Five addresses, spread over the period February-June, have been arranged as part of the centenary celebrations of University College. The speakers include Prof. E. H. Starling, on "A Century of Physiology" on Feb. 28, and Sir Oliver Lodge, on Mar. 14, at 8.30 P.M., on "A Century's Progress in Physics."

MANCHESTER.—The Council has accepted the resignation of Prof. W. W. C. Topley from the chair of bacteriology and the directorship of the public health laboratory as from September next, when he will take up his duties as professor of bacteriology and immunology in the new London School of Hygiene and Tropical Medicine.

Mr. W. O. Howarth, lecturer in botany, has been appointed to supervise research in mycology under the scheme of the British Empire Cotton Growing Corporation. Mr. H. G. Chippindale has been appointed research assistant in mycology under the same scheme.

Calendar of Discovery and Invention.

March 7, 1785.—Among the landmarks in the history of geology was the publication of James Hutton's "Theory of the Earth: or an Investigation of the Laws observable in the Composition, Dissolution, and Restoration of Land upon the Globe," read to the Royal Society of Edinburgh on Mar. 7 and April 4, 1785. It attracted little attention at the time, but ten years later Hutton published his views in two volumes, and in 1802 Playfair wrote his "Illustrations of the Huttonian Theory of the Earth."

March 8, 1618.—Searching for a simple relation which would connect the distances of the planets with their times of revolution, Kepler found after long calculation that the square of the time in which a planet revolves round the sun is proportional to the cube of the average distance of the planet. This, he said, first occurred to him on Mar. 8, 1618, and two months later he recognised the absolute truth of a principle for which he had been searching for seventeen years.

March 9, 1720.—Halley succeeded Flamsteed as Astronomer Royal.

March 9, 1862.—A fight which revolutionised sea warfare took place in Hampton Roads, U.S.A., on Mar. 9, 1862. The *Monitor*, Ericsson's famous ship, there met the *Merrimac*. The *Monitor*, "a fort upon a raft," carried two 11-inch guns in a revolving turret. The *Merrimac*, a converted 40-gun frigate, had six 9-inch, two 7-inch, and two 6-inch guns. The fight was in the nature of a duel and was inconclusive, but from that time dates the introduction of the turret, advocated by Ericsson in America and Cowper Coles in England.

March 10, 1809.—Founded in 1807, the Geological Society at first took the form of a dining club, and some members wished that it should be regarded as an assistant association of the Royal Society. This, however, did not meet with general approval, and on Mar. 10, 1809, a resolution was passed "that any proposition tending to render this Society dependent upon or subservient to any other society does not correspond with the conceptions the meeting entertains of the original principles upon which the Geological Society was founded."

March 12, 1683.—Geological maps were first suggested by Martin Lister, who on Mar. 12, 1683, read to the Royal Society "An ingenious proposal for a new sort of Maps of Countrys, etc."

March 12, 1782.—Watt's grand improvements in the steam engines were set down in four patents. His first patent contained the important inventions of the separate condenser and air-pump; his second describes devices for obtaining rotary motion. The date of the third patent is Mar. 12, 1782, and in this he makes a claim for a double acting engine and for using the steam expansively. To these several improvements he added the throttle valve, the parallel motion, the centrifugal governor, and the indicator.

March 12, 1884.—Two pioneers whose efforts gave a great impetus to the utilisation of electric energy were John Dixon Gibbs and Lucien Gaulard. In Paris in 1881 they produced a "secondary generator," an improved form of which was patented on Mar. 12, 1884. Their system of distribution was used in London in a portion of the Metropolitan Railway, and also for lighting Regent Street and Oxford Street. Though when judged by present-day standards their secondary generators appear crude pieces of apparatus, they were the forerunners of the present-day transformers. E. C. S.

Societies and Academies.

PARIS.

Academy of Sciences, Jan. 24.—E. Goursat: A problem of the theory of surfaces.—F. E. Fournier: The inclination θ, always favourable to the speed of a ship, that its satellite wave gives to its plane of flotation, in a calm sea.—F. W. Perkins: The resolution of the problem of Dirichlet.—André Roussel: The ensembles of equally continuous functionals.—G. Sugot: The gyroscopic movement of a projectile.—P. Dejean: The influence of compression on the fragility of steel. The existence of a limit of fragility.—Léon Bouthillon: The inclination of [electromagnetic] waves and directed systems.—E. Brylinski: The relative velocity of the earth and the neighbouring ether. A. Picard and E. Stahel have described the results of experiments which they regard as opposed to the conclusions of Miller, based on experiments at Cleveland and at Mount Wilson. The author shows that the two series of experiments, regard being had to the possible errors, are really in agreement.—Léon and Eugène Bloch: The spark spectra of bromine. A list of lines in the E_1 and E_2 spectra between wavelengths λ6353 and λ2338.—Paul Riou: An apparatus for measuring the rates of absorption of gases by liquids. A description, with diagram, of an apparatus for determining the rate of absorption of a gas by a liquid.—Mario A. da Silva: A new determination of the period of polonium. The method is based on the determination of the ionisation produced in pure argon by the α-rays of polonium: the period found is 140·2 days.—J. Huggett and G. Chaudron: The temperatures of magnetic transformations in the system iron–ferric oxide.—Jolibois and Chassevent: An apparatus for the thermal analysis of plaster. Details of a calorimetric method which gives the velocity of hydration of plaster of Paris, capable of controlling and classifying commercial products more conveniently than by chemical analysis.—P. Job: The cuprammonium ion and its stability. Determinations of the equilibrium constant under varying conditions show that the $Cu(NH_3)_4$ ion is the only ion stable at the ordinary temperature.—Marcel Delépine: The oxidation with permanganate of pyridine and the pyridine nucleus. The pyridine nucleus is readily oxidised by acid permanganate solutions, the nitrogen appearing mainly as ammonia with some as nitric acid.—Marcel Godchot and Pierre Bedos: The action of organo-magnesium compounds on the oxide of cycloheptene. Cycloheptene oxide is isomerised by the action of CH_3MgI, and the cycloheptanone thus formed (suberone) then reacts with the magnesium compound in the ordinary manner.—V. Hasenfratz: The preparation and properties of *l*-arabonic and *l*-ribonic lactones.—L. Royer: The regular joining up of cubic salts on mica.—N. Menchikoff: The crystalline and volcanic rocks of the centre of the Libyan desert.—Léon W. Collet and R. Perret: The geology of the Col d'Anterne and of the Cirque des Fonts (Sixt Alps, Haute-Savoie).—Albert Baldit: Magnetic measurements in the south-west of the Central Massif.—K. Tsukamoto: The transparency of sea water for the extreme ultra-violet. From experiments on synthetic salt solutions, it is concluded that absorption in the extreme ultra-violet by sea water is due to the presence of small quantities of bromides.—Pierre Allorge: The vegetation of the sphagnum peats of Galiad (Spain).—L. Blaringhem: The affinities of the wild wheats *Triticum ægilopoides* and *T. monococcum*, demonstrated by their reciprocal hybrids.—Emile André: A new and abundant source of trilaurin; the seed of the Mahuba, *Acrodiclidium Mahuba*. Of the family of the Lauraceæ, this seed contains about half its weight of a fat consisting of fairly pure trilaurin.—H. Lagatu and L. Maume: Control of the mode of nutrition of a perennial plant (vine) in a given soil receiving a given manure.—Henri V. Vallois: The variations of the spinal muscles in the higher primates.—P. Vignon: The primitive nervation of the wings of insects and the changes from the original plan in the Orthoptera.—Jules Amor: Observations on biological similitude.—Georges Bourguignon: Double innervations in the human organism, discovered by pathological and normal electrophysiology and controlled by anatomy.—Henri Piéron: The law which connects the surface of the wings with the weight of the individual in the same animal species, and some problems concerning the flight of insects. The wing surface in one species studied (*Libellula sanguinea*) is a linear function of the weight supported.—G. Lefrou: The anticoagulating power of certain dyes and organic arsenic compounds.—Raymond-Hamet: The point of vascular attack of the ergot alkaloids.—André Bonot and Théophile Cahn: The estimation of arginine in pure proteids and tissues by a modified Jansen method.—E. Roubaud and J. Colas-Belcour: The action of diastases in determining the eclosion of the egg in the mosquito of yellow fever (*Stegomyia fasciata*).—Bordier: General principles and technique of the new treatment of Heine-Medin's disease (infantile paralysis).

BRUSSELS.

Royal Academy of Belgium, April 10, 1926.—P. Stroobant: Report of the work done by the National Committee of Astronomy during the year 1925.—P. Teilhard de Chardin: Some new mammals from the Belgian Tertiary.

May 4.—Paul Stroobant: Note on the discovery of two new minor planets at the Royal Observatory, Uccle.—A. Demoulin: Determination of the differential invariants and integral invariants of surfaces for the conformal group.—A. Demoulin: The method of the mobile birectangular trihedron and some of its applications.—A. Demoulin: The surfaces of Guichard.—Maurice Nuyens: The electrodynamics of bodies in motion.—Constant Lurquin: The stable algorithms of probability.—Marc de Hemptinne: Latent heats of evaporation. The formula proposed by Maurice Prud'homme, $\log L = \log a + n \log (T_c - T)$, in which L is the latent heat of evaporation, T the absolute boiling-point under atmospheric pressure, T_c the critical temperature, and k, a, and n constants, has been compared with experimental data for water, ammonia, pentane, hexane, heptane, octane, carbon tetrachloride, chlorobenzene, fluorenzene, benzene, methyl and ethyl acetates, and methyl alcohol, and shown to be generally applicable.—W. Mund and J. d'Olieslager: The kinetics of ozone formation under the action of the α-particles. For a given intensity of irradiation by α-particles, ozone is formed with constant velocity, and at the same time is destroyed with a velocity proportional to its concentration.—J. Errera: The polarisation of a medium and its molecular structure. The cases of benzene and cyclohexane. From the experimental work described it is concluded that neither of these hydrocarbons has a permanent dipole.

June 5.—G. Cesàro: The formula of some Vesuvian silicates.—Edm. van Aubel: The viscosity of liquid chlorine. According to A. J. Batschinski, the specific volume of a normal liquid is a linear function of the fluidity. The experimental data of E. W. R. Steacie and F. M. G. Johnson and of Maurice Jellaton on the

viscosity of liquid chlorine are shown to be in agreement with Batschinski's formulæ, except for the temperature, −33·8° C., in the neighbourhood of the boiling-point.—Edm. van Aubel: The viscosity of fused salts. The viscosities of fused salts (silver nitrate, potassium nitrate, lithium nitrate, sodium nitrate, silver chloride, bromide, and iodide) given by various authors, are all in agreement with Batschinski's formula.—M. Dehalu: The movement of the perihelion of mercury deduced from certain laws of gravitation.—Th. De Donder: A contribution to the electromagnetic tensor and to the mechanical force of Maxwell-Lorentz.—A. Demoulin: The method of the mobile birectangular trihedron and some of its applications.—Georges Homès: The ionisation of gases and Saha's equation.—R. Moens: An ionisation phenomenon of mercury vapour under low pressure.—Mlle. A. Binard and R. Jeener: Researches on the morphology of the nervous system of the annelids.—Henri Fredericq: Demonstration, by chronaximetric measurements, of the direct bathmotropic action of the extrinsic nerves of the heart.

CALCUTTA.

Asiatic Society of Bengal, Jan. 3.—J. H. Hutton: (1) A Naga Hills celt. Description of a unique specimen found at Nichuguard, at the foot of the Naga Hills. It is a stone adze of a new type; the material is fossilised (silicified) wood and it is presumably local in origin. (2) Some megalithic work in the Jaintia Hills. There is some connexion between stone-erecting and water. Megalithic bridges exist near Maput village and across the Um-nyakaneh River. The abandoned European Inspection Bungalow near Syndai is locally attributed to ancient native origin. There are rock-cut tanks near the Am-sorai stream and dolmens and slabs near the Am-lubon River. There is some similarity between the Syntengs and Manipuris and Ao Nagas.—Jayme Ribeiro: The caves of Sewri. Bombay is rich in natural cavities and fairly large caves are to be found in the vicinity of this city. The caves as yet discovered skirt the eastern coast line of the Island from Jackeria Bunder to a point a little to the north of the Sewri cemetery, both on the east and west of it. More will no doubt be found, but only to disappear by being covered over with buildings. Detailed descriptions of two of the caves and a general description of the strata are given.

ROME.

Royal National Academy of the Lincei, Dec. 5.—U. Cisotti: Uniformisants of non-uniform functions.—G. Scorza: Real algebraics united to groups of finite order.—L. Cambi and L. Szegö: Constitution and absorption spectra of the iron nitrososulphides. The absorption spectra of compounds containing the grouping $-S.Fe.N_2O_2$ or $-S_2O_3.Fe.N_2O_2$ exhibit certain analogies to those of the ferric compounds $Fe(N_2O_2C_6H_5)_3$ and $Fe(CNS)_3$. In highly dilute solutions the salt $KS_3\ Fe_4(NO)_7$ gives spectra indicating the presence of ferrous iron, just as is the case with $FeSO_4.NO$. The absorption of light by the above nitrososulphides reveals no characteristic justifying the view that these compounds contain univalent iron.—L. Rolla and L. Fernandes: A new element: Florentium (atomic number 61). A copy is given of a communication preserved under the seal of the Academy since July 4, 1924, and priority claimed for the discovery and naming of this element.—F. Sacco: The question of the age of the ophitiferous argillaceous shales of Appennino.—B. Finzi: Relative kinetic energy.—G. Vranceanu: Equations of the motion of an anolonomous system.—U. Barbieri: Absolute azimuth of Eremo di Cherasco, on the horizon of Mondovi.—R. Brunetti: Existence of the element of atomic number 61. Results obtained in 1924 and kept under seal by the Academy since July of that year deal with the absorption spectra of certain specimens of rare earths. From the character and disposition of a discontinuity observed in the spectral region between samarium and neodymium, the presence in the material of the element of atomic number 61, missing from Mendeléeff's table, is presumed.—R. Brunetti: Identification of the element with atomic number 61. This element has been identified by means of the *K* spectrum.—U. Crudeli: Electro-magnetic fields having the electric (magnetic) field zero at the circumference and the magnetic (electric) field tangential.—F. De Carli: Additive products of sulphur dioxide with aromatic hydrocarbons. Note ii. In addition to the compounds recently described, sulphur dioxide forms with ethylbenzene the compounds $C_6H_5.C_2H_5,\ SO_2$, melting at −91° and $C_6H_5.C_2H_5,\ 2SO_2$, melting at −78·5°; with cymene the compounds $CH_3.C_6H_4.C_3H_7,\ SO_2$, melting at −89° and $CH_3.C_6H_4.C_3H_7,\ 2SO_2$, melting at −83°, and with tetraline the compounds $C_{10}H_{12},\ SO_2$, melting at −58°, $C_{10}H_{12},\ 2SO_2$ melting at −66·2° and $C_{10}H_{12},\ 3SO_2$, melting at −70°.—G. Magnanini: The Bohr model and the supposed coloration of the ions. Both experimental results and deductions on the basis of Arrhenius's theory show that the dissociated part of a coloured electrolyte has always the same absorption spectrum as the non-dissociated part. This is not in accord with Bohr's theory, so that either electrolytic dissociation is a spontaneous process having nothing in common with true dissociation as produced, for example, by the spark discharge, or the explanations furnished by Bohr's theory with regard to the intimate constitution of matter are inaccurate.—C. Capelletti: The bacteroid form and immunity in leguminous plants.

Pontifical Academy of Sciences, Jan. 16.—Hagen: Nebula N. G. C. 1193. Opinions contrary to those of Herschel are shown to be erroneous.—Hagen: The surface connected with a curve of space.—Kaas: A strange case of hypersensibility.—Carathéodory: Theory of analytic functions.—Zanon: Diatomaceæ of a Venetian peat.—Borghesani: A wine from a wild grape of Central America.—Borghesani: Treatments of wine for the celebration of mass.—Neviani: *Equorfossa Farnesinæ* Nev.—A. Marotti: A noteworthy class of permanent plane motions of a perfect liquid.

VIENNA.

Academy of Sciences, Dec. 9.—L. Schmid and G. Bilowitzki: Communication on insulin. Molecular weight determinations in phenol showed that insulin is highly polymerised in that solvent.—L. Gröger: Coloration and luminescence phenomena in Iceland spar after previous treatment with Becquerel rays.—E. Lohr: Additions to the continuity theory of Röntgen-ray propagation in crystals.

Dec. 16.—A. Haas: The increase of frequency in light-quanta by impact with swiftly moving particles of matter (see NATURE, Feb. 19, p. 296).—K. Brunner and J. Medweth: The course of the reaction in Brunner's synthesis of triazol.—W. Gabl and O. Schmidegg: Derivatives of phenyl-dimethyl-triazol.—H. Hernler and F. Matthes: The nitrification of phenyl- and naphthyl-triazols.—A. Kieslinger: Geology and petrography of the Kor Alps.—F. Heritsch and N. Stücker: The Mürzzuschlag earthquake of July 6, 1926.

Official Publications Received.

BRITISH.

Scientific Reports of the Agricultural Research Institute, Pusa (including the Reports of the Imperial Dairy Expert, Physiological Chemist, Government Sugarcane Expert, and Secretary, Sugar Bureau), 1925–26. Pp. vi+212. (Calcutta: Government of India Central Publication Branch.) 2.8 rupees; 4s. 6d.

Agricultural Research Institute, Pusa. Bulletin No. 165: List of Publications on Indian Entomology, 1925. (Compiled by the Imperial Entomologist and the Offg. Imperial Entomologist.) Pp. ii+62+x. (Calcutta: Government of India Central Publicat on Branch.) 12 annas; 1s. 3d.

Bath Royal Literary and Scientific Institution. Address delivered on July 10th, 1926, by Dr. F. A. Bather on William Smith, 'The Father of English Geology.' Pp. 14+4 plates. (Bath.) 6d.

National Institute of Industrial Psychology. Institute Report No. 1: Occupation Analysis; the Study of Aptitudes and Attainments necessary for Success in different Kinds of Employment. Pp. iv+36. (London.) 2s.

FOREIGN.

Department of the Interior: Bureau of Education. Bulletin, 1926, No. 6: Personnel and Organization of Schools in the small Cities (2,500 to 10,000 Population, 1924–25). By Prof. Harry S. Ganders. Pp. iv+36. 10 cents. Bulletin, 1926, No. 16: A Handbook of Educational Associations and Foundations in the United States. Pp. iii+82. 15 cents. Bulletin, 1926, No. 17: Record of Current Educational Publications; comprising Publications received by the Bureau of Education to July 1, 1926. Pp. 41. 10 cents. Bulletin, 1926, No. 20: Higher Education; Biennial Survey, 1922–1924. By Arthur J. Klein. Pp. ii+29. 5 cents. (Washington, D.C.: Government Printing Office.)

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 538: Spectral Energy Distribution of the Light emitted by Plants and Animals. By W. W. Coblentz and C. W. Hughes. Pp. 521-534+2 plates. (Washington, D.C.: Government Printing Office.) 10 cents.

University of California Publications in American Archæology and Ethnology. Vol. 23, No. 3: The Emeryville Shellmound; Final Report. By W. Egbert Schenck. Pp. 147-282+plates 35-54. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.) 1 dollar.

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 18: Typen van den Regenval in Nederlandsch-Indië (Rainfall Types in the Netherlands Indies). Door (By) Dr. J. Boerema. Pp. iii+103+2 maps. (Weltevreden.)

Publikationer fra det Danske Meteorologiske Institut. Meddelelser Nr. 6: Om Isforholdene i Danske Farvande Aarene 1861–1906. (Fortsættelse af Meddelelse Nr. 2). Av. C. I. H. Speerschneider. Pp. 83. (København: G. E. C. Gad.)

Société des Nations: League of Nations. Bulletins de l'Institut International de Cooperation intellectuelle: Bulletins of the International Institute of Intellectual Co-operation. Bulletin des relations scientifiques: Bulletin for Scientific Relations. 2me année. No. 1, Février. Pp. 137-228. (Paris: Les Presses universitaires de France.) 8 francs.

United States Department of Agriculture. Department Circular 395: The Oriental Peach Moth. By Alvah Peterson and G. J. Haeussler. Pp. 28. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the United States National Museum. Vol. 70, Art. 8: Some Braconid and Chalcid Flies from Formosa, Parasitic on Aphids. By A. B. Gahan. (No. 2657.) Pp. 7. (Washington, D.C.: Government Printing Office.)

CATALOGUES.

Eastman Organic Chemicals. List No. 16, January. Pp. 78. (Rochester, N.Y.: Eastman Kodak Co.)

Artificial Sunlight. Bulletin No. 80, Supplementing Catalogue, Part 3, Section 5. Pp. 46. (London: Watson and Sons (Electro-Medical), Ltd.).

Bulletin of Development covering the Twelve Months ending June thirtieth, 1926. Pp. 31. (London: Adam Hilger, Ltd.)

Century Motors, Single Phase and Polyphase. (List No. A30.) Pp. 24. (London: Swedish General Electric, Ltd.)

International Press Exhibition, Cologne, May-October 1928. Pp. 24. (Cologne.)

Catalogue of Important Works on Gardening and Botany. (No. 148.) Pp. 40. (London: Dulau and Co., Ltd.)

Catalogue de livres anciens et modernes rares ou curieux relatifs à l'Amérique et les régions polaires. Pp. 48. (Paris: Librairie Adrien-Maisonneuve.)

Wild-Barfield Small Electric Furnaces for Works and Laboratories, and for all Purposes requiring the Accurate Maintenance of High Temperatures. Section H. Pp. 16. (London: Automatic and Electric Furnaces, Ltd.)

Diary of Societies.

SATURDAY, MARCH 5.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.

GEOLOGISTS' ASSOCIATION (in Department of Zoology, University College), at 2.30.—Prof. D. M. S. Watson: Demonstration of Some Early Fossil Vertebrates.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. J. B. McEwen: Beethoven (2).

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at Rochdale), at 6.30.—W. H. Poole: The Foundry Cupola.

INSTITUTE OF BRITISH FOUNDRYMEN (Birmingham, Coventry, and West Midlands Branch) (at Engineers' Club, Birmingham), at 6.30.—F. J. Cook: Some Experiences in the Production of Malleable Castings.

HULL ASSOCIATION OF ENGINEERS (at Technical College, Hull), at 7.15.—E. Hall: Civil Engineering Experiences in South America.

MONDAY, MARCH 7.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Prof. T. G. Pinches: The Completed Legend of Bel-Merodach and the Dragon.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Peoples of the East: Past and Present (3). An Account of the Earliest Sumerians so far Discovered, the Description being based on a Study of Human Remains found at and near Ur of the Chaldees by the Joint Expedition of the British Museum and of the Museum of the University of Pennsylvania under the leadership of Mr. C. Leonard Woolley.

SOCIETY OF ENGINEERS (at Geological Society), at 5.30.—M. E. Gerard: The Raising of a 1250-ton Coal Bunker after a 7-ft. Subsidence.

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—H. R. Ricardo: Some Notes on Petrol-Engine Development.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—Capt. P. P. Eckersley and others: Discussion.

GLASGOW UNIVERSITY ALCHEMISTS' CLUB (Annual General Business Meeting), at 7.30.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—J. MacMurray: The Place of Experiment in Knowledge.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—Prof. W. E. S. Turner: Recent Progress in the Glass Industry.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section, jointly with General Society) (at Royal Anthropological Institute), at 8.—Prof. J. Piaget: La première année de l'enfant.

INSTITUTION OF THE RUBBER INDUSTRY (London and District Section) (at Engineers' Club, Coventry Street, W.1), at 8.—P. Dunsheath: Some Electrical Properties of Rubber.

SURVEYORS' INSTITUTION, at 8.—Discussion on Leasehold Reform.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Rt. Hon. W. Ormsby-Gore: Some Nigerian Contrasts.

INSTITUTE OF CHEMISTRY (Manchester and District Section) (at Manchester).—Prof. E. C. C. Baly: Plant Chemistry.

TUESDAY, MARCH 8.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. W. F. Dearden: Health Hazards in the Cotton Industry (Milroy Lectures) (3).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. S. Huxley: Problems of Animal Growth and Development (6).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Dr. A. Wade: Two Shallow Oilfields in Texas.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. E. B. Poulton: Gynandromorphism in Butterflies following Shock to the Pupæ.—Dr. H. H. Scott: Report on the Deaths occurring in the Society's Gardens during the Year 1926.—Prof. D. M. S. Watson: The Reproduction of the Cœlacanth Fish Undina.—Dr. R. Broom: (*a*) On a New Type of Mammal-like Reptile from the South African Karoo Beds; (*b*) Some Further Points on the Structure of the Mammalian Basicranial Axes.—Dr. N. S. Lucas, E. M. Hume, and H. H. Smith: On the Breeding of the Common Marmoset (*Hapale jacchus* Linn.) in Captivity when irradiated with Ultra-Violet Rays.

INSTITUTION OF CIVIL ENGINEERS, at 6.—A. W. Stonebridge: The Tansa Completion Works for the Water Supply of Bombay.

INSTITUTION OF AERONAUTICAL ENGINEERS (at Junior Institution of Engineers), at 6.30.—Major H. N. Wylie: Portable Hangars.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—W. F. Rabbidge: The M.A.N. Internal Combustion Engine and other Types.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—Capt. P. P. Eckersley and others: Discussion on Wireless as a Factor in World Communication.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—Dr. W. H. Eccles: Address.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—J. W. T. Walsh: Illuminating Engineering.—H. T. Harrison: The Problems of Public Lighting by Electricity.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel, Edinburgh), at 7.—L. C. Grant: High-Power Fusible Cut-outs.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Annual General Meeting.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (Annual Meeting) (at Birmingham University), at 7.30.—H. W. Rowell: The Commercial Synthetic Resins and their Product (Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Middlesbrough), at 7.30.—G. B. Butler: From Ironstone to Finished Product.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—S. R. Wycherley: A Fortnight in Sark with a Microscope.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.—J. E. Barnard: The Microscope and its Use in Research (Lecture).

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—R. Firth: The Exchange of Gifts in Primitive Societies.

INSTITUTE OF BREWING (London Section) (at Engineers' Club, Coventry Street, W.1).

WEDNESDAY, MARCH 9.

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 A.M.—Presidential Address.—Prof. D. Hanson and Grace W. Ford: Investigation of the Effects of Impurities on Copper. Part V. The Effect of Bismuth on Copper.—Prof. D. Hanson and C. B. Marryat: Investigation of the Effects of Impurities on Copper. Part III. The Effect of Arsenic on Copper. Part IV. The Effect of Arsenic plus Oxygen on Copper.—C. Blazey: Brittleness in Arsenical Copper.—At 2.—D. F. Campbell: Electric Furnaces in Non-Ferrous Metallurgy, and a General Discussion on Electric Furnaces in Non-Ferrous Metallurgy.

INSTITUTION OF CHEMICAL ENGINEERS (Conference) (at Chemical Society), at 5.—W. C. Freeman: The Production of Dissolved Acetylene and its Application to Lead Burning.—S. J. Tungay: Lead as a Constructional Material in Chemical Engineering.—At 8.—Dr. H. J. Bush and A. Grounds: The Function of the Schmiedel Box in Sulphuric Acid Manufacture.—W. G. Mills: Some Improvements in Chamber Sulphuric Acid Plant.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Peoples of the East: Past and Present (4). The Racial Characters of Sumerians and Babylonians and their Relationship to other Peoples.

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—A. H. Douglas: Traverse Surveys.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—J. W. T. Walsh: Illuminating Engineering.—H. T. Harrison: The Problems of Public Lighting by Electricity.

ELECTRICAL ASSOCIATION FOR WOMEN (at E.L.M.A. Lighting Service Bureau, Strand), at 7.—Simple Household Repairs—Fuses, Lampholders, Bells, etc.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—J. H. Frith: Grinding.

ROYAL SOCIETY OF ARTS, at 8.—Dr. E. W. Smith: The Utilisation of Gas Coke.

MEDICAL SOCIETY OF LONDON, at 9.—D. J. Armour: The Surgery of the Spinal Cord and Membranes (Lettsomian Lectures) (2).

THURSDAY, MARCH 10.

INSTITUTE OF METALS (Annual General Meeting) (at Institution of Mechanical Engineers), at 10 A.M.—R. Genders: The Penetration of Mild Steel by Brazing Solder and other Metals.—J. H. Miller: The Penetration of Brass by Tin and Solder, with a Few Notes on the Copper-Tin Equilibrium Diagram.—H. J. Hartley: The Attack of Molten Metals on Certain Non-Ferrous Metals and Alloys.—H. Moore and S. Beckinsale: Notes on the Manufacture and Properties of Hair Springs.—F. Hargreaves: (*a*) The Application of Strain Methods to the Investigation of the Structure of Eutectic Alloys; (*b*) Note on the Crystallisation of the Lead-Tin Eutectic.—At 2.—J. D. Grogan: The Influence of Calcium on Aluminium containing Silicon. With an Appendix on The Estimation of Calcium in Aluminium Alloys, by P. G. Ward.—M. Hansen: The Magnesium-Rich Magnesium-Copper Alloys.—R. Genders: The Mechanism of Inverse Segregation in Alloys. With an Appendix on The Accurate Determination of Copper in Bronze by Electrolysis, by R. A. F. Hammond.—Prof. Kôtaro Honda and Prof. Hikozo Endo: Magnetic Analysis as a Means of Studying the Structure of Non-Magnetic Alloys.—Prof. B. W. Holman: An Etching Reagent for Copper.—Dr. J. Newton Friend and W. E. Thorneycroft: (*a*) Examination of a Fifteenth Century Brass: (*b*) Note on the Silver Contents of Roman Lead from Folkestone and Richboro Castle.

ROYAL SOCIETY, at 4.30.—A. Levin and J. Wyman: The Viscous Elastic Properties of Muscle.—A. Hynd: The Action of Glucosone on Normal Animals (Mice) and its Possible Significance in Metabolism.—Dr. F. W. R. Brambell and Dr. A. S. Parkes: Changes in the Ovary of the Mouse following Exposure to X-Rays.—Dr. A. S. Parkes, Una Fielding, and Dr. F. W. R. Brambell: Ovarian Regeneration in the Mouse after Complete Double Ovariotomy.—A. Walton: The Relation between 'Density' of Sperm-Suspension and Fertility as determined by Artificial Insemination of Rabbits.

INSTITUTION OF CHEMICAL ENGINEERS (Conference) (at Chemical Society), at 5.—B. D. Porritt: Rubber as a Constructional Material in Chemical Engineering.—At 8.—Prof. F. C. Lea: The Effect of Heat on some of the Properties of Metals.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—Dr. G. M. B. Dobson: The Measurement of the Absorption Coefficients of Light Filters.—Ibbs and Underwood: A Comparison of the Behaviour in Thermal Diffusion of Nitrogen and Carbon Monoxide, and of Nitrous Oxide and Carbon Dioxide.—R. R. Nimmo: The Relighting of a Neon Lamp when Momentarily Extinguished at Voltages below the Striking Potential.—D. B. Deodhar: The Electrification of Dust Clouds.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Prof. F. R. Fraser: Cardiac Dyspnœa (Goulstonian Lectures) (1).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. Garstang: The Progress of Hittite Studies (3).

SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY (at Hibernia Chambers, London Bridge), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—G. H. Taylor: The Jubilee Year of the Telephone.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—B. Graves: Microscopy of the Living Eye.

ROYAL SOCIETY OF MEDICINE (Neurology Section) (at National Hospital, Queen Square, W.C.1), at 8.

HARVEIAN SOCIETY (at Paddington Town Hall), at 8.30.—Sir Berkeley Moynihan: Diverticula of the Alimentary Canal (Harveian Lecture).

OIL AND COLOUR CHEMISTS' ASSOCIATION.

INSTITUTION OF THE RUBBER INDUSTRY (Manchester Section) (at Manchester).—N. Blond: Difficulties of Rubber Proofed Garment Manufacture.

FRIDAY, MARCH 11.

INSTITUTION OF CHEMICAL ENGINEERS (Annual Corporate Meeting) (at Hotel Victoria), at 12.—Sir Frederic Nathan: Some Industrial Developments and the Chemical Engineer (Presidential Address).—At 2.30.—F. H. Rogers: The Cross Cracking Process and Plant.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall), at 3.—P. A. Holliday: High-Revolution Oil Engines.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—R. Mather: The Iron and Steel Industry in India.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Prof. F. Schlesinger: Astronomical Photography of Precision (George Darwin Lecture).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: The Peoples of the East: Past and Present (5). The People of Egypt, Past and Present, and their Position in a Classificatory System.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section, jointly with Students' Sections of Institutions of Civil and Mechanical Engineers) (at Institution of Electrical Engineers), at 6.15.—A. C. Price: Patents.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Annual Meeting.

INSTITUTION OF AUTOMOBILE ENGINEERS (North of England Centre) (at The Temple, Dale Street, Liverpool), at 7.—A. F. Evans: Ships' Lifeboat Motors.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—A chat with Mr. B. Lemere on Architectural Photography.

INSTITUTE OF METALS (Swansea Local Section) (at University College, Swansea), at 7.15.—Dr. F. Johnson: The Influence of Oxygen on Copper and other Non-Ferrous Metals.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—J. Wolstenholme: The Design, Construction, and Operation of the Cupola.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—I. Lubbock: Oil Fired Furnaces.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. G. Macdonald: The Wall of Hadrian.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Manchester).—Dr. S. Smith: Cellulose Ester Varnishes: their Manufacture, Properties, and Application.

SATURDAY, MARCH 12.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District) (at Bath), at 12.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. J. B. McEwen: Beethoven (3).

PUBLIC LECTURES.

SATURDAY, MARCH 5.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Harcourt: Some Poisonous Snakes of India.

SUNDAY, MARCH 6.

GUILDHOUSE (Eccleston Square), at 3.30.—Dr. C. Delisle Burns: Experimental Religion.

MONDAY, MARCH 7.

KING'S COLLEGE FOR WOMEN (Household and Social Science Department), at 5.15.—Mrs. Rackham: Justice and the Citizen.

UNIVERSITY OF LEEDS, at 5.15—Dr. T. Slater Price: Photographic Sensitivity.—At 8.15.—Sir Henry Hadow: Beethoven.

TUESDAY, MARCH 8.

SURVEYORS' INSTITUTION, at 5.30.—Major G. H. Scott: The Development of Airship Transport (Lecture).

WEDNESDAY, MARCH 9.

UNIVERSITY COLLEGE, at 5.30.—Sir William Schooling: Photography of Documents: Object and Methods.

THURSDAY, MARCH 10.

UNIVERSITY OF LIVERPOOL, at 4.—Prof. V. Putti: New Conceptions in the Pathogenesis and Treatment of Sciatica (Lady Jones Lecture).

UNIVERSITY COLLEGE, at 5.—Prof. E. A. Gardner: History of Ancient Sculpture.

ROYAL SOCIETY OF MEDICINE, at 5.15.—Dr. C. F. Coombs: Rheumatism—its Causes and Prevention: The Chronic Rheumatic Diseases (Chadwick Lecture).

KING'S COLLEGE, at 5.30.—Prof. C. G. Seligman: The Mind: Anthropology.

SATURDAY, MARCH 12.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Trading in Ancient Egypt.

SUNDAY, MARCH 13.

GUILDHOUSE (Eccleston Square), at 3.30.—Major W. Tudor Pole: Universalism in Religion, with special reference to the Bahai Faith.

CONGRESSES.

APRIL 20 TO 24.

JOURNÉES MÉDICALES MARSEILLAISES ET COLONIALES (at Marseilles).—Prof. Cantacuzène: The Rôle of the Streptococcus in the Etiology of Scarlet Fever.—Dr. Mayer: Recent Advances in the Treatment of Cancer.—Prof. Ottolenghi: Malaria.—Dr. N. Bernard: Beri-beri.—Prof. Imbert: Bone-grafting.

APRIL 25 TO 28.

GERMAN SOCIETY FOR INTERNAL MEDICINE (at Wiesbaden).—Discussions on Psychotherapy, introduced by Gaupp and Fleischmann; Results of Recent Functional Investigations of the Stomach and Duodenum, introduced by G. Katsch.—A joint meeting with the German Röntgen Society will be held on April 28, with a discussion on the Significance of Röntgen-ray Examination of the Lungs and Mediastinum for Internal Medicine (excluding Tuberculosis), introduced by Dietlen, Assmann, Haenisch and Lorey, and Fleischner.

Supplement to NATURE

No. 2992 MARCH 5, 1927

Our Bookshelf.

Human Evolution.

Éléments de sociologie : textes choisis et ordonnés. Par Prof. C. Bouglé et J. Raffault. (Publications du Centre de Documentation sociale.) Pp. viii + 506. (Paris : Félix Alcan, 1926.) 30 francs.

A COLLECTION of extracts such as MM. Bouglé and Raffault have compiled has its manifest uses as a source book and work of reference. This, however, has not been the primary or even the main object of its preparation, although the course of the Écoles Normales has been followed in the chief features of its framework. It is intended as a manifesto and reply to those who maintain the unsuitability of sociology as a subject of instruction on the ground that it is too young a science to have become sufficiently systematised and adequately provided with principles of general application to afford a suitable discipline. The compilers desire to refute this criticism by submitting to the reader what sociological writers have actually said, instead of entering into abstract argument. In England, perhaps, we have been fortunate ; any controversy on this point being almost forgotten owing to an early acceptance of the evolutionary principle in its application to sociological data. Early exuberance, it is true, has had to be overcome, but the scientific attitude remains. This, however, does not affect the fact that for English readers, equally with French or those of any other tongue, this is a stimulating book in which the views of sociologists of to-day, yesterday, or long ago, on specific points arising out of a sociological scheme, may be found in their most characteristic form.

Grundriss der Anthropologie. Von Dr. M. W. Hauschild. Pp. viii + 235. (Berlin : Gebrüder Borntraeger, 1926.) 10·50 gold marks.

THE reviewer, after a perusal of this work, laid it down with the feeling that anthropology has suffered a profound loss by the death of its young author, Dr. Wolfgang Hauschild. In a preface written by his old teacher, Prof. Eugen Fischer, director of the Anthropological Institute of the University of Freiburg, we learn that Dr. Hauschild, after carrying out arduous investigations in Java during 1924, died from malaria on his way home, leaving behind him the manuscript of this work. One suspects that his text was intended to serve as a basis for a systematic course of lectures on the evolution and structure of human races, and that the condensation of his argument, although expressed in clear, simple German, would have been lightened and expanded by a free use of illustrative examples. It is plain, at least, that this rising anthropologist had addressed himself, not to the dilettante, but to the serious student of his subject.

The book is of particular interest to senior anthropologists, because it reveals the methods which the rising generation of investigators in Germany are applying to the problems of human evolution and of human heredity, and the ideals by which they are moved. Dr. Hauschild at once captures the English reader by ascribing to Darwin the just merit of being the sole author and initiator of the evolutionary movement which now moves thoughtful men in all parts of the world. He gives Mendel his due place—a very high one. The revolution in physical anthropology which Dr. Hauschild evidently anticipated was to arise from a fuller knowledge of the processes which regulate the development and growth of the human body. He has attempted to base his subject on physiological or biological principles, and for this reason has brought to bear on the human body the latest information gleaned from all branches of modern science. We see in this book a young author causing new sciences to leaven old knowledge, and all has been done in a logical, masterful way. We heartily commend this book to every one who wishes to get into touch with the best work now being done in the anthropological laboratories of Germany.

Prehistory.

Préhistoire de la Norvège. Par Haakon Shetelig. (Instituttet for Sammenlignende Kulturforskning. Serie A : Forelesninger, 5.) Pp. vi + 280 + 10 planches. (Oslo : H. Aschehoug and Co. ; London : Williams and Norgate, Ltd. ; Leipzig : Otto Harrassowitz ; Paris : Honoré Champion ; Cambridge, Mass. : Harvard University Press, 1926.) 7*s.* 6*d.*

DR. SHETELIG, the distinguished Norwegian archæologist, some four years ago published a review of the state of knowledge of prehistoric Norway at that date. Unfortunately for most readers it was in Norwegian, and the present volume, though written on a slightly different plan, as well as covering a more extended field, will be welcomed by those who wish to make themselves acquainted with the views of this authority on the archæology

of his own country and its many problems. In his preface, Dr. Shetelig points out that the conditions, geographical and climatic, as well as the sparse population of early days, give the archæology of Norway a special character and, be it said, a peculiar significance. The salient problems throughout arise from the fact that the most marked characteristic of Norwegian culture is its receptivity and not its power of initiation. Norwegian culture, although individual, is a part of Scandinavian culture as a whole, and this in turn, although also distinctive, is an integral part of the general European culture. The task of the archæologist, therefore, is to analyse the data in such a way as to distinguish the foreign element and mark the modification by which it becomes essentially Norwegian.

The reader will follow with interest the method by which Dr. Shetelig has worked out this theme in tracing the development of Norwegian civilisation from the Maglemose period to the Viking age. In view of the use made of the early rock carvings in supporting the argument for the inheritance of palæolithic culture, as well as in the interests of the chapter on art, it is to be regretted that the book has not been more fully illustrated.

Frühschein der Kultur: Bilder aus Vorgeschichte und Urzeit. Von Prof. Dr. Johannes Ledroit. Pp. ix + 257. (Freiburg im Breisgau: Herder und Co. G.m.b.H., 1926.) 4·80 gold marks.

This well-planned little book aims at awakening the interest of the layman, and more especially of school-pupils, in prehistory by a lively and graphic presentation of the main facts. The outstanding features of each chief cultural period from Lower Palæolithic to Roman times are first briefly sketched. An imaginative description of some supposedly typical incidents from the epoch in question is added to fill in the details. We are introduced, for example, to a 'wandering artist' who winters in the cave of some reindeer-hunters and then passes on to another shelter after having adorned his hosts' abode with representations of bisons and other animals. We see the *Urgermanen* from the North Sea raiding the villages of the Michelsberg folk and witness the burial of a chief in a megalithic tomb. A description is given of a bronze age smithy and of the visit of a travelling dealer with copper and tin from England, who, with the aid of his 'slaves,' eventually carries off the smith's beautiful Nordic daughter.

Dr. Ledroit has carefully collected all the scattered scraps of archæological evidence that might help to complete a concrete picture of life in those remote times. There is less evidence of a mastery of the ethnographic data that might be invoked to supplement this inevitably fragmentary record, and a few mistakes have crept in. The bronze-worker may well have used the *cire perdue* process, but it is wrong to make him execute the spiral decoration on the finished casting; the mammoth is said to be a metre taller than existing elephants.

Birds.

(1) *L'Évolution de l'ornithologie.* Par Dr. M. Boubier. (Nouvelle Collection scientifique.) Pp. v + 308. (Paris: Félix Alcan, 1925.) 10 francs.

(2) *Birds and their Attributes.* By Dr. G. M. Allen. Pp. xiii + 338 + 34 plates. (London, Calcutta and Sydney: George G. Harrap and Co., Ltd., 1926.) 10*s.* 6*d.* net.

(3) *Les oiseaux: l'ornithologie et ses bases scientifiques.* Par Dr. M. Boubier. (Encyclopédie scientifique: Bibliothèque de zoologie.) Pp. iv + 305. (Paris: Gaston Doin et Cie., 1926.) 22 francs.

(4) *Fugle.* 2: *Lomfugle, Stormfugle, Vandhøns, Tranefugle og Vadefugle.* Ag R. Hørring. (Danmarks Fauna, 30.) Pp. 332. (København: G. E. C. Gads Forlag, 1926.) n.p.

(1) In the steady stream of books about birds it is pleasant to find one which breaks new ground, as does Dr. Boubier's "L'Évolution de l'ornithologie." In a series of eight chapters he takes up particular aspects of ornithology and traces the gradual growth of knowledge in each branch of the science, marking the stages of development by appeal to the works of the masters. Thus he discusses the knowledge of the European avifauna, the results of explorations and voyages, the study of migration, of taxonomy, anatomy, and palæontology, and the development of systems of classification, and under each head the history is traced succinctly yet with sufficient detail to give a connected picture of progress. In so comprehensive a work omissions are bound to occur, and we note that no English writer on bird migration is mentioned later than Barrington (1772), and that although many and lesser bird-ringing schemes are referred to, the *British Birds* scheme which has been responsible for the marking of some 146,000 birds passes unnoticed.

(2) Dr. Allen's volume is excellent, although it belongs to a very familiar type—an introduction to a general survey of birds, their structure, habits, and human relations. It is outstanding because of the author's familiarity with recent literature, and his knack in selecting a telling example, as in the case of the narrow Atlantic belt which bars the distribution of two sets of terns (p. 155), or the Ceylon telegraph wire which bore an annual crop of mistletoe seedlings (p. 165), or the relation of the extent of a bird's migration to the shape of the egg it lays (p. 177). Of the illustrations the most remarkable are Mr. Bigelow's photographs of the V-shaped flight formations of swans and geese.

(3) In this other work of Dr. Boubier's we have a general treatise on birds, aiming less at the general reader than at the ornithologist who would add a scientific ground-work to his own observations. It is noteworthy for its conciseness, and for the care with which the comparative anatomy of birds is treated. A number of rough but very instructive diagrams illustrate the text.

(4) This, the second volume of a handbook of the birds of Denmark, deals with the divers, grebes, petrels, rails, and waders. The characters of the various species are indicated in key-tables, summer and winter plumages are described, a lengthy section gives an account of the migrations, habits, and status in Denmark of each species, and each description is accompanied by an excellent illustration in half-tone of the bird itself. J. R.

Systematic Zoology.

Handbuch der Zoologie: eine Naturgeschichte der Stämme des Tierreiches. Gegründet von Prof. Dr. Willy Kükenthal. Herausgegeben von Dr. Thilo Krumbach. Vierter Band: *Progoneata, Chilopoda, Insecta.* Erste Lieferung. Pp. 128. 13 gold marks. Zweite Lieferung. Pp. 129-240. n.p. Fünfter Band: *Solenogastres, Mollusca, Echinodermata, Tunicata.* Dritte Lieferung. Pp. 177-256. 8 gold marks. (Berlin und Leipzig: Walter de Gruyter und Co., 1926.)

THE fourth volume of Kükenthal's treatise opens with a short explanation of the extinction of the term Myriapoda, which has lost its strict systematic significance.

After a definition of the class Progoneata, the author, Dr. Carl Graf Attems, passes to the consideration of the constituent subclasses — Symphyla, Pauropoda, and Diplopoda—their anatomy, developmental stages, ecology, distribution, and classification. The sections on the Symphyla and Pauropoda are short—each about 9 pages—but that on the Diplopoda extends to more than 200 pages, and gives an admirably complete account of this subclass and its affinities. The classification is done in great detail—into orders and then into genera. The space devoted to systematics is disproportionately large, and we hope it may not result in restricting the pages available for the account of the Insecta in the later part of the volume. The parts are well illustrated, and at the end of the account of each class is a list of works of reference.

The first quarter of section 3 of vol. 5 contains the conclusion of the account—the development, ecology, and classification—of the Bivalvia. The rest of the part is devoted to the Cephalopoda, the description of which by Prof. J. Thiele is on the lines of the two preceding parts of the volume already noticed in NATURE. He gives a fair account of the anatomy, but finer structural details receive insufficient consideration, and reference to some of the newer work is lacking, for example, to the recent views on symbiotic organisms in relation to the luminous organs, to the details of formation and discharge of the remarkable spermatophores, and to the young stages of Spirula.

More illustrations would have been welcome in this section; particularly of important aspects such as the egg-cleavage and later stages of development, and the histology of the statocysts, eyes, and chromatophores.

Die Tierwelt der Nord- und Ostsee. Herausgegeben von G. Grimpe und E. Wagler. Lieferung 5. Teil 9.d_1: *Lamellibranchia*, von F. Haas; Teil 12.a_1: *Copelata*, von A. Bückmann. Pp. 96 + 20. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) 8·80 gold marks.

THESE new parts of "Die Tierwelt der Nord- und Ostsee" maintain the high standard set by those already published. The greater part consists of a well-balanced account of the lamellibranchs by F. Haas; it is perhaps to be regretted that he uses the older classification based mainly on the teeth and hinge of the shell, rather than the newer classification by means of the gill structure, but he provides what will be of great service to the marine biologist, namely, good keys to the genera and species. There is an interesting account, illustrated with good tables, of the distribution of all the species and, in addition, a very brief summary of the present state of our knowledge regarding their structure and physiology is included.

The bionomics of the lamellibranchs—a subject of the utmost importance—are given due prominence by the author, both from the ecological and utilitarian points of view. Limnoria, however, is better considered as the precursor than as the enemy of Teredo, although the author admits that if it increased at the expense of Teredo "Teufel durch Beelzebub ausgetrieben würde."

The concluding pages of the parts before us are devoted to a short and very clearly illustrated account of the Copelata (Appendicularіæ), which has been contributed by A. Bückmann.

Les arachnides de France. Par Eugène Simon. Tome sixième. Deuxième partie: *Le synopsis général et le catalogue des espèces françaises de l'ordre des Araneæ (suite).* Œuvre posthume publiée par L. Berland et L. Fage. Pp. ii + 309-532. (Paris: L. Mulo, 1926.) 25 francs.

THIS part does not complete the supplement to "Les Arachnides de France." It deals with two sub-families of the Argiopidæ—the Theridiosomatinæ and Erigoninæ. The former contains the genus Theridiosoma, which is in some respects a link between the Theridiidæ and Argiopidæ and is represented in France and Great Britain by one species only. In the Erigoninæ thirteen new genera have been created without the addition of any new species, which seems somewhat drastic treatment. Some of the generic distinctions are slight and the generic characters will in some cases be more difficult to determine than the specific ones.

This part will be something of a disappointment to British arachnologists, who have been anxiously awaiting the remainder of this volume in the hope that the British and European classification of spiders might once and for all be unified. It is certainly a valuable contribution but falls short of our hopes.

Grundriss der allgemeinen Zoologie: für Studierende. Von Prof. Dr. Alfred Kühn. Zweite, verbesserte und vermehrte Auflage. Pp. viii+261. (Leipzig: Georg Thieme, 1926.) 13·20 gold marks.

In the first 84 pages the author gives an account, necessarily very condensed, of the various phyla. It is difficult to estimate whether some of the sections, *e.g.* one page of text for the sponges, about ten lines for the Ctenophora, six lines for the Bryozoa and for the Myriapoda respectively, will serve to convey to the student an adequate idea of the groups concerned. The author may depend largely on the laboratory instruction for the building up of the student's knowledge of structure, and the brief accounts may be intended chiefly for purposes of revision. The second part of the work (about 70 pages) deals with physiology—food and its transportation in the body, production of energy, respiration, excretion, animal heat, chemical relations between the organs, movement, reactions to stimuli. The final section of about 80 pages is devoted to embryology, heredity, and the origin of species. The figures are diagrammatic and clear; there is a list of works of reference and an adequate index.

Special Biological Studies.

Evolution im Lichte der Bastardierung betrachtet. Von J. P. Lotsy. Aus dem Englischen übersetzt von H. N. Kooiman. (Separat Abdruck aus *Genetica*, 7.) Pp. iii+365-470. (Haag: Martinus Nijhoff, 1926.) 4 guilders.

Early in 1925, Dr. J. P. Lotsy, at the invitation of the university colleges of New Zealand, delivered there three lectures on "Evolution considered in the Light of Hybridisation." These were afterwards published by Canterbury College, together with an introduction and an appendix by Dr. L. Cockayne, giving a list of more than 200 supposed wild hybrids in the New Zealand flora. These lectures have now been translated into German by Dr. H. N. Kooiman. The original edition was illustrated by eleven photographs of Mirabilis hybrids. These are replaced in the German edition by a coloured plate illustrating the remarkable range of fruit types obtained in the F_2 and F_3 generations from a cross between two varieties of pumpkin or squash.

So early as 1921, Dr. Cockayne had observed natural hybrids of Nothofagus and other genera growing wild in profusion, and he gives reasons why New Zealand is a particularly suitable place for their evolutionary study. Nevertheless, if natural species-hybrids are so abundant in the New Zealand flora, they must be of common occurrence elsewhere. In polymorphic genera, such as Rubus, Cratægus, Rosa, and Hieracium, the polymorphism is now, as the result particularly of cytological work, generally recognised to have arisen in connexion with crossing, and the number of such cases will no doubt be much extended.

Dr. Lotsy in his lectures has brought together many new and interesting data bearing on the subject. The statement of his views is less extreme than formerly, but he still leans very heavily upon the hybridisation hypothesis in places where it seems unnecessary. Although he admits that real mutations may take place, yet he invents terms such as 'sub-haploid' and 'super-haploid' hybridisation for processes with which geneticists have long been familiar as germinal changes, *e.g.* various processes by which new chromosome numbers arise. Why he assumes that such changes can only occur in Nature as a result of crossing it is difficult to see, since it is well known that some of them at least can be produced experimentally by changes in the conditions. Dr. Lotsy's view appears at its weakest in dealing with adaptations. Thus he suggests that the leafless Cacti and Euphorbiae may have arisen by the crossing of leafy succulent forms, the leafless offspring afterwards finding their way into the desert.

We think the author would strengthen his case if instead of trying to make hybridisation a universal evolutionary factor, he recognised it as merely one of the conditions under which the evolution of sexual organisms has taken place. He thinks evolution was made possible by sexuality, but he makes no attempt to explain the evolution of non-sexual organisms. R. R. G.

Der Formwechsel der Protistenkerne: eine vergleichend-morphologische Studie. Von Dr. Karl Bělař. (Sonderabdruck aus *Ergebnisse und Fortschritte der Zoologie*, Band 6.) Pp. 420. (Jena: Gustav Fischer, 1926.) 22 gold marks.

The author has made a thorough study not only of the literature of the Protozoan nucleus, but also of numerous specimens in various phases of nuclear activity. As he remarks, the newest developments of research in heredity have brought the nuclear changes in the Metazoa into the very centre of interest, but in the Protozoa genetical studies are only beginning, and much remains to be accomplished in this and in other connexions in the study of their nuclei. It is well, therefore, that the known facts have been brought together in such an accurate and orderly manner, for the limitations of our knowledge and the directions in which further investigations are required are more readily realised.

After a survey of the 'resting' nucleus, the author passes to the consideration of the various forms of mitosis and amitosis. He points out that amitotic nuclear division, formerly believed to be widespread in the Protozoa, appears normally to occur in the macronucleus of the Ciliata and in a few other cases only, and most of the latter are doubtful. The more interesting examples are carefully described.

The account of the behaviour of the nucleus preparatory to and during fertilisation includes a summary of present knowledge of the meiotic phase. A list is given of the number of chromosomes in nearly one hundred Protozoa, in some twenty of which the diploid and haploid numbers are stated. The nuclear changes which take place during the vegetative period are traced, the rela-

tionships between the nucleus and the cytoplasm and other components of the organism, *e.g.* flagella, cilia, trichocysts, are discussed and the spindle and centrosome are described. The last chapter is devoted to the more important views on the constitution of the protozoan nucleus, and includes a series of diagrammatic figures representing the different modes of division of the nucleus in the various groups of Protozoa.

In order not to burden the text with quotations from authors, Dr. Bělař has placed these, together with his remarks on them, in an appendix of some sixty pages. There is an extensive list of references and an index to the genera and species mentioned in the volume.

The accurate and critical treatment of this difficult subject has resulted in a volume which will be of great use to those who contemplate the investigation of the nucleus not only of the protozoa but also of the fungi and of the algæ. Special praise is due to the author and to the publisher for the abundance and excellence of the illustrations (many of them original) and for the detailed legend with which each is provided.

Die Pflanzenareale: Sammlung kartographischer Darstellungen von Verbreitungsbezirken der lebenden und fossilen Pflanzen-Familien, -Gattungen und -Arten. Unter Mitwirkung von Prof. Dr. Ludwig Diels und Prof. Dr. G. Samuelsson. Herausgegeben von Prof. Dr. E. Hannig und Prof. Dr. H. Winkler. 1 Reihe, Heft 1. Pp. iii+14+10 Karten. Heft 2. Pp. 19-34+11-20 Karten. (Jena: Gustav Fischer, 1926.) 7.50 gold marks.

THAT the study of the distribution of plants is becoming of increasing importance in systematic work is being more and more realised. The controversial theories put forward by Willis (age and area) and by Wegener (continental drift), even if they have done nothing else, have been the means of stimulating a new interest in this branch of botany. A comprehensive work on the subject has now been commenced in Germany under the above title, edited by Drs. E. Hannig (Munster) and H. Winkler (Breslau), with the assistance of Drs. L. Diels (Berlin) and G. Samuelsson (Stockholm). The two parts issued are very large quarto, similar in appearance to the well-known "Vegetationsbilder" of Karsten and Schenck.

In Part 1 Prof. Engler gives an account of the distribution of Saxifraga, subsection Hirculoidea, to which are devoted three large maps. Other authors deal with the distribution of various genera and species of plants in a similar manner, amongst them *Genista anglica*.

In Part 2 Prof. H. Winkler shows the area occupied by the banana family, Musaceæ, in a wild state, and another map indicates graphically the range of the species of Musa under cultivation. Prof. Pax gives a short account of the genus Sapium and shows the distribution of the sections proposed by him in "Das Pflanzenreich." Other botanists deal with the range of various trees. In the case of the European and Mediterranean species of Abies, Dr. Mattfeld gives no less than two full pages of bibliographical references, in contrast to Prof. Pax's three references for Sapium. The work is somewhat unwieldy, resulting in considerable waste of space. For example, Karte 2 shows the distribution of three species of Saxifraga in a very small area of Central Asia on a circumpolar map about 10 in. × 14 in. A more judicious selection of sectional maps might easily have reduced the first part to at least half of its present proportions.

Polarised Light in Biology.

(1) *Handbuch der biologischen Arbeitsmethoden.* Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 191. Abt. 2: *Physikalische Methoden*, Teil 2, Heft 2. *Die Verwendung der Polarisationsmikroskops für biologische Untersuchungen.* Von August Köhler. Pp. 907-1108. (Berlin und Wien: Urban und Schwarzenberg, 1926.) 9·30 gold marks.

(2) *Das Polarisationsmikroskop: seine Anwendung in der Kolloidforschung und in der Färberei.* Von Hermann Ambronn und Albert Frey. (Kolloidforschung in Einzeldarstellungen, Band 5.) Pp. x+195. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) 13.50 gold marks.

THESE volumes represent recent additions to two series of 'handbooks' dealing with experimental methods in biology and the study of colloids respectively. The polarisation microscope, once finding its application exclusively in orthodox crystallography, is now being applied to the study of what Sir William Bragg so expressively terms "the imperfect crystallisation of common things."

The highly regular molecular arrangements often found in such objects as vegetable fibres, nerve filaments, cell walls, and so on, frequently leads to double refraction of large amount, which is measured without difficulty by the highly refined methods originally developed for mineralogical purposes.

(1) Köhler's discussion is arranged largely as a series of experiments designed to illustrate the main applications of the polarisation microscope, the determination of the directions of the axes of the index ellipse (the 'fast' and 'slow' directions), the use of the Sénarmont compensation systems, etc., all being thoroughly explained on physical principles with the minimum of mathematics. The optical features of konoscopic methods are also carefully treated, and a number of representative biological and colloidal applications are discussed. Unfortunately, the separate volumes of this series are not given an individual index, which somewhat detracts from the utility of each section by itself, but it is meant to be read in conjunction with Köhler's previously issued volumes on the microscope in the same series, and will be found clear and adequate.

(2) The volume by Ambronn and Frey will be found useful for readers more familiar with physics, and covers the ground rather more rapidly than the volume above. The latter half of the book is

devoted to the physical applications of the various methods; a valuable section deals with the results of O. Wiener's "Theorie des Mischkörpers," another with liquid anisotropism, and so on. Part 3 deals with the various optical methods employed to glean information as to the structure of dispersoids, and the directions of the particles. Celluloid and rubber are among the substances specifically discussed. The name of Richard Zsigmondy, the editor of the series, will be a guarantee of the reliability of this 'handbook,' which naturally explains much of the recent work of the authors.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 205. Abt. 2: *Physikalische Methoden*, Teil 2, Heft 4. *Polarimetrie*, von Heinrich Kessler; *Spektroskopische Methoden des Mediziners*, von Fritz Löwe; *Nephelometrie*, von Marie Anna Schirmann. Pp. 1345-1536. (Berlin und Wien: Urban und Schwarzenberg, 1926.) 8·70 gold marks.

FULL theoretical accounts of the subjects of polarimetry, spectroscopy, and nephelometry are given, together with descriptions of selected pieces of apparatus. The accounts are written from the point of view of the biologist rather than the physicist, especially the section dealing with spectroscopy, in which special reference is made to the blood pigments. The work should be consulted by all those interested in these particular branches of biological methods.

Modern Physics.

Die elektrische Leitfähigkeit der Atmosphäre und ihre Ursachen. Von Prof. Dr. Victor F. Hess. (Sammlung Vieweg, Heft 84-85.) Pp. viii + 174. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1926.) 8.50 gold marks.

As at once a professor of experimental physics and a field observer, Dr. V. F. Hess is specially fitted to write a general text-book on atmospheric electricity, and we learn from the preface that a work of this character by himself and his colleague at the University of Gratz, Prof. H. Benndorf, is in preparation. The present work deals with only part of the subject, and even within its ostensible limits it is not apparently regarded as altogether exhaustive. On one or two points the more extensive work in contemplation is referred to for further information, and in particular it will supplement the bibliography of the present work, though that is fairly extensive.

In the main the book treats of the electrical charges in the atmosphere and their origin. The theory of the Gerdien and Ebert apparatus is discussed, and the various methods of investigating the radioactive phenomena of the atmosphere. Various allied questions, *e.g.* the electricity of rain and thunderstorms, are only lightly touched on. As a pioneer investigator of the penetrating 'cosmic' radiation, Dr. Hess naturally gives special attention to that subject. He traces its development from the independent discovery by Gockel and C. T. R. Wilson of the ionisation in closed vessels, followed by the field work of McLennan, Wright, and others, then by the balloon observations by Gockel, Kolhörster, and himself, and finally by the recent work of Kolhörster and Millikan. He objects not unreasonably to the term 'Millikan rays' used by some Americans, but in his references to the conductivity of the upper atmosphere—a subject on which he supplies most up-to-date information—he makes free use of the term Kennelly-Heaviside layer, to which like exception can be taken.

The book so far as it goes may claim to replace the earlier German text-books by Gockel and by Mache and v. Schweidler, and within its sphere it is not inferior to the recent French works. It is interesting to note that in the name index at the end, the references to Elster and Geitel are only as numerous as those to Kolhörster, and only half as numerous as those to Prof. W. F. G. Swann. Dr. Hess does not, however, seem to notice that if the somewhat serious defect in the Ebert apparatus which he accepts as proved by Prof. Swann really exists, then much of the information which appears in the present book and elsewhere respecting negative ions must require correction. The view is taken that if satisfactory results are to be obtained in the open, the Ebert apparatus must be surrounded by a large mesh earth-connected wire screen. This seems a matter which deserves international consideration. C. CHREE.

Müller-Pouillets Lehrbuch der Physik. Elfte Auflage. Herausgegeben von A. Eucken, O. Lummer, und E. Waetzmann. In fünf Bänden. (1) Band 2: *Lehre von der strahlenden Energie (Optik)*. Erste Hälfte. Bearbeitet von O. Lummer. Pp. xviii + 928 + 7 Tafeln. 50 gold marks. (2) Band 3: *Wärmelehre*. Erste Hälfte: *Physikalische chemische und technische Thermodynamik (einschl. Wärmeleitung)*. Bearbeitet von Arnold Eucken. Pp. xviii + 1185. 63 gold marks. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1926.)

THIS eleventh edition of one of the best-known German treatises on physics is the first that has appeared since the War. It shows conclusively that Germany is neither forced nor willing to abdicate her former leading position in the matter of exhaustive text-books.

(1) This volume may be regarded as Dr. Otto Lummer's last legacy to humanity. It was already in type when he died in July 1925, and has been finally brought out by A. Eucken and E. Waetzmann. It is significant of modern developments that the conception of an ether of space, which in the late pre-War years seemed to be losing ground, has to some extent been rehabilitated by the generalised theory of relativity, and particularly by the system worked out by Weyl in 1918. These theories regard the electromagnetic field and the gravitational field as two aspects of the 'metric' field which comprises all phenomena of time and space. The old contrast between

matter and ether is eliminated by the conception of matter as condensed and 'grained' energy in the gravi-electromagnetic ether.

The present volume covers the same ground as the corresponding volume of the tenth edition, except that spectrum analysis and phosphorescence are relegated to a further volume. The chapters on the eye and on optical instruments are entirely rewritten, and there are many additions to the chapter on interference and (especially) on prism combinations.

(2) The third volume, which deals with heat, has been subdivided, and while the book under notice deals with thermal phenomena in general, the next subdivision will deal exclusively with the kinetic theory.

It is literally true that the whole of the work has been rewritten. In this particular volume we find none of the old names. Pfaundler, Drucker, Wassmuth, and Hann are replaced by Eucken, Ebbecke, Jakob, Magnus, and others, and the bulk of the work has been done by Eucken, who celebrated his eightieth birthday this year!

It suffices to say that the new editors have carried out their great task in the spirit and tradition of the original work. No greater praise is necessary. "Müller-Pouillet" still stands unrivalled among 'elementary' text-books of physics which aim at being at the same time clear, accurate, and complete.

Anregung von Quantensprüngen durch Stösse. Von Prof. Dr. J. Franck und Dr. P. Jordan. (Struktur der Materie in Einzeldarstellungen, Band 3.) Pp. viii + 312. (Berlin: Julius Springer, 1926.) 19·50 gold marks.

THIS book is an up-to-date account of the work done in recent years on this interesting and fertile subject, a field of inquiry which is associated with the names of Franck, Hertz, Paschen, and Heisenberg in Germany, of Fowler and Horton in Great Britain, and of numerous contributors to the *Physical Review* in America. The first chapters describe and discuss the kinetics of slow-moving electrons in gases and vapours, the determination of critical potentials by the electron impact method and the relations between critical potentials and the spectral terms of atoms. Succeeding chapters discuss in detail the possibilities of excitation and of ionisation of atoms by electron impacts, and give a well-balanced account of collisions 'of the second kind.' In the seventh chapter an account is given of the critical potentials of molecules, especially those of hydrogen, nitrogen, oxygen, and the halogens. The concluding chapter deals briefly with the applications of the results obtained to chemical reactions.

From the first experimental work of Franck and Hertz to the latest theoretical speculations of Heisenberg is indeed a far cry. Perusal of this book will convince a reader to what extraordinary ramifications of physics the discovery of the electron and the application of quantum ideas to the structure of the atom have led. The subject is a difficult one; difficult both in its fundamental concepts and in the manner in which these are expressed, but one which every physicist must, and every physical chemist should, attempt to understand. It is a great boon, therefore, to have this up-to-date, fully documented compilation in the well-digested form which Prof. Franck and Dr. Jordan have given us. Both the experimental and theoretical sides of the work are adequately treated. To many this book will make a difficult subject reasonably clear and simple for the first time; it is a book which we whole-heartedly recommend to all students of physics.

Chemistry and Colour.

La chimie des matières colorantes organiques. Par Dr. Pierre Castan. (Encyclopédie scientifique: Bibliothèque de chimie.) Pp. 456. (Paris: Gaston Doin et Cie, 1926.) 30 francs.

THE editor of the "Chemical Library," of which this book forms a unit, does not aim at producing dictionaries or books of reference, but books that will be *read* not by the chemist alone, but also by those who are interested in other branches of science, and by the general reader. The complete library will contain some eight volumes on general chemistry, twelve on inorganic chemistry, and eleven on organic chemistry, of which this volume is the second to appear.

The author is to be congratulated on having produced a most readable book, of which the opening chapter on the relation between the colour and constitution of organic compounds is a remarkably clear exposition of this important problem. In the succeeding eight chapters the chemistry of the different classes of synthetic dyestuffs is discussed, the final chapter being devoted to the naturally occurring colouring matters. Within the limited scope of the present volume there is no place for a section dealing with the chemistry of dyestuff intermediates; it is to be hoped that this serious omission will be rectified in some succeeding volume of the series.

Pyrosole: das kolloide Phänomen in der glühend Flüssigen Materie und seine Erstarrungszustände. Unter Berücksichtigung des latenten photographischen Bildes. Von Prof. Dr. Richard Lorenz und Prof. Dr. Wilhelm Eitel. (Kolloidforschung in Einzeldarstellungen, Band 4.) Pp. ix + 290 + 20 Tafeln. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) 20 gold marks.

COLLOIDAL solutions in which the continuous medium is solid at ordinary temperature are common in industrial processes, but owing to the experimental difficulties of investigating them, they have received less attention than solid-liquid systems. Prof. R. Lorenz is a pioneer in this field, and the monograph gives a summary of our knowledge of metal fogs in fused salts, coloured glasses, and the colloidal materials in minerals and slags. The consideration of similar solid colloidal solutions formed by the action of light leads naturally to an account of modern work on the

photohalides and the latent photographic image. The excellent and numerous illustrations assist in making the book exceptionally interesting and useful.

Miscellany.

Tabulæ Biologicæ. Ed. W. Junk. Herausgegeben von C. Oppenheimer und L. Pincussen. Band 3: *Allgemeine Chemie, Konstanten chemischer Verbindungen, Chemie der Organe, Stoffwechsel, Grösse und Massen-Verhältnisse beim Menschen, Pharmakologie, Immunität.* Pp. vi + 829. (Berlin: W. Junk, 1926.) 63*s*.

THE contents of the third volume of "Tabulæ Biologicæ," which we have recently received, are somewhat inadequately indicated by the short titles of the different sections, given above. A vast amount of information of interest to physiologists and biochemists may be found here, which, in general, appears to be adequate and up-to-date. Thus the formulæ and chemical and physical constants of all the better-known substances on which physiologists and pharmacologists may require information are given in this volume; data are provided on the different natural and synthetic drugs used in medicine, including a most useful table of the innocuous, toxic, and lethal doses of a great variety of compounds. This volume also contains data on the chemistry of different organs and on metabolism; in the latter section may be found such information as the oxygen and sugar consumption of different tissues, the heat value and composition of different foodstuffs, and the physical constants of man himself at all ages. Whilst, as is perhaps inevitable in a work of this kind, equal stress is laid on data which may be of unequal value owing to the differences in the number of experiments on which the figures are based, and whilst in places the data themselves appear inadequate, as, for example, the table on the vitamin content of different foods, yet our thanks are due to the editor and his collaborators for providing biologists with such readily accessible information on a wide variety of subjects, culled from so many different sources.

Die Kriegsschauplätze 1914–1918 geologisch dargestellt. Herausgegeben von Prof. Dr. J. Wilser. In 14 Heften. Heft 14: *Die Isthmuswüste und Palästina.* Von Dr. Paul Range. Mit einem Beitrage von Dr. Walter Hoppe: *Paläontologie und Paläogeographie der Jura- und Kreideschichten der Isthmuswüste.* Pp. vi + 82. (Berlin: Gebrüder Borntraeger, 1926.) 11·40 gold marks.

DURING the War, Dr. P. Range was attached to the German-Turkish forces operating in Palestine to advise on the important matter of water-supply, and so had the opportunity of making a fairly detailed geological reconnaissance of the coastal plain of Palestine and the desert of northern Sinai (the Isthmus Desert) to the south. His chief observations have already been published in a number of papers in German periodicals, and include the discovery of important exposures of Jurassic rocks in the Maghara Range, in northern Sinai—a discovery in which, however, he had been anticipated by a Frenchman, M. Couyat-Barthoux, a year or two previously.

Since the War, a number of important papers on the geology of Palestine have appeared from other quarters also, and it is gratifying to note that the recent important discoveries of marine Trias and Jura in nearer Transjordania have been made by British geologists.

In including an account of these recent advances the present volume fulfils a useful purpose. It rather supplements than replaces the section on Palestine in Prof. M. Blanckenhorn's volume, "Syrien, Arabien, und Mesopotamien," published in 1914 in the "Handbuch der regionalen Geologie." Very little is said about the structural features of the region and their history, most of the book dealing purely with the stratigraphy. For a treatise of its size, too much space is filled by long lists of fossils, copied from recent palæontological papers on the area. Dr. W. F. Hume will be surprised to see himself referred to on p. 2 as "der inzwischen verstorbene Direktor der Geological Survey of Egypt."

Exercices de calcul différentiel et intégral. Par l'Abbé Potron. Premier volume: *Résumé théorique et énonces d'exercices.* Pp. xviii + 332. (Paris: J. Hermann, 1926.) 35 francs.

MOST of the standard French treatises on mathematical analysis expound the subject in a way that gives but little help to a student by supplying him with exercises to test his progress. The volume before us is welcome as a useful supplement to such treatises. It contains more than a thousand unworked examples on the differential and integral calculus, including their geometrical applications, and on differential equations. Many of the problems have been proposed as examination questions in the French universities, and show the tendency of mathematical thought there in recent years. Short and unexhaustive notes on the theoretical groundwork involved are added, but the book is in no sense a treatise on infinitesimal calculus. Although the range covered aims at being a wide one, there are omitted many branches of the subject with which every well-trained mathematical student should be familiar.

W. E. H. B.

L'Art musical dans des rapports avec la physique. Par Prof. Jean Becquerel. (Extrait du tome 2 du *Cours de Physique.*) Pp. iv + 79. (Paris: J. Hermann, 1926.) 6 francs.

JEAN BECQUEREL has the unique distinction of being the fourth in a direct line of distinguished physicists extending over more than a century, and occupying, moreover, the same official position in the National Museum, Paris. This portion of the author's "Cours de Physique" is separately reprinted in a handy form useful to both musicians and physicists. In the question of melodic scales it supports Helmholtz as against the strict Pythagoreans.

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