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The Radcliffe Observatory and its Proposed Removal.

THE British National Committee for Astronomy of the International Research Council has pronounced definitely in support of the proposal to transfer the Radcliffe Observatory, Oxford, to South Africa, rather than to another site in England. This was the view taken at a meeting of the Committee held on May 9, when it was also resolved "that the establishment in South Africa, under English control, of a new observatory equipped with a large reflector, and adequately endowed, would not only be in the best interests of astronomy, but is almost an imperative necessity in the interests of British scientific prestige". The resolution appears in full in our correspondence columns this week over the signatures of sixteen of the seventeen members of the Committee present. A glance at the list of names should be sufficient to convince anyone that leading astronomical opinion in Great Britain is decidedly in favour of carrying on the scientific work of the Radcliffe Observatory in South Africa instead of continuing it in England.

Dr. John Radcliffe, whose name the Observatory bears, was a successful Court physician who died in 1714 leaving a fortune estimated at £140,000. His will provided for the building of a library in Oxford and the salary of a librarian, for travelling fellowships, for rebuilding the front of University College, Oxford, and some other purposes. When the bequest of £40,000 allocated to the library became available upon the death of Radcliffe's sisters, the trustees built the Radcliffe Library and later the infirmary. The residue of the real and personal estate remaining after the payment of various legacies and bequests was to be used by the trustees for "such charitable [purposes] as they in their discretion shall think best". There is no mention of astronomy in Radcliffe's will, and it was not until more than fifty years after his death that the trustees decided that the practical study of this science might be regarded as a charitable purpose and that they could therefore make provision for it.

The Savilian professorship of astronomy was founded in 1619 by Sir Henry Savile, Provost of Eton. Shortly after Dr. Hornsby succeeded to the chair in 1762, he appealed through the Chancellor of the University to the Radcliffe trustees for funds for an observatory, and in 1771 they secured a lease (and in 1820 the freehold) of nearly nine acres for the building and grounds adjoining the Radcliffe Infirmary, which was opened a year earlier. Shortly afterwards the building was put in hand, the trustees

having previously agreed to purchase the instruments suggested by Hornsby. These were completed and delivered in 1773 and are still in the observatory. The building was not, however, finished and furnished until towards the end of the eighteenth century. Several additions have since been made, including a building for an equatorial telescope in 1903.

From the foundation of the Observatory until 1839 the Savilian professor and Radcliffe observer was a joint office, but the University then elected a successor to Dr. S. P. Rigaud without consulting the Radcliffe trustees, with the result that the trustees appointed an observer of their own, and the chair of astronomy has since then been separated from the post of Radcliffe observer.

The trustees then asserted their independence, as they can in their discretion with the sum which will be at their disposal if the Charity Commissioners consent to the proposed sale of the present site of the Radcliffe Observatory for the use of the Radcliffe Infirmary. As the Observatory has been in existence for more than 150 years, it is reasonable to assume that astronomy has a substantial vested interest in the sale of property which it has possessed for so long a period. It seems too late now to urge that as astronomy is not mentioned in Radcliffe's will, the sum available from the sale of the Observatory site should be used for other than astronomical purposes. Probably the trustees will give consideration to any such claims which may be advanced, but it scarcely seems possible now to dispute their legal right to continue to use for astronomy the benefaction which they have administered for so long for the promotion of that branch of science.

Assuming, therefore, that the trustees have a substantial sum at their disposal, there seem to be two points of view as to how this might be used—one that of Oxford itself and the other that of science, which knows no geographical limitations and welcomes facilities for increase of natural knowledge anywhere. It must be acknowledged, of course, that every scientific department at Oxford could make good use of the fund for the development of fields of inquiry which they are unable to explore because of lack of resources, but we wonder whether any department would be inclined to hand over to a separate branch of science an endowment which it had held for a century and a half. In comparison with other subjects, astronomy is very poorly endowed in Great Britain or the British Empire. The suggestion that it might now transfer to other departments of science one of its few endowments cannot, therefore, be seriously entertained.

The position at present is that the Charity Commissioners have the proposed sale of the Observatory site under consideration. Even if consent is given, the future site of the Observatory cannot be definitely settled for many months yet. The present intention of the Radcliffe trustees, for which they hope to obtain legal sanction, is to move the activities to a site on the high veld in South Africa, in view of the excellent observing conditions there and the pressing need of more work on the southern stars. Dr. Steavenson is at present testing the seeing at a site outside Pretoria, using the same method as is being employed in the search for a site for the 200-inch reflector in California. If the Observatory goes to South Africa, it is planned that it should be equipped with as large a reflector as the trust can afford, possibly a 72-inch, as there is an immense field of spectroscopic work, which such a telescope alone can do, awaiting to be done to complement similar work in the northern hemisphere.

From the point of view of progress of astronomical science, the advantages to be gained by the establishment of an observatory in South Africa are beyond dispute. Practically all the most important astrophysical work is now done with large reflectors, like the 72-inch telescope used by J. S. Plaskett at the Dominion Astrophysical Observatory, Canada. His work on the rotation of the galaxy and the interstellar cloud especially needs to be extended to the southern sky.

It would be easy to mention many other profitable lines of work for which a large reflector is required in the southern hemisphere, and also where observing conditions are more favourable than in England. All observing work requiring long exposures, and all photometric work, is carried on here with difficulty and disappointment on account of uncertainties of weather; and this is harder on large telescopes than on small. It is indeed unnecessary to labour the point that a big reflector is urgently needed for line of sight and other spectroscopic work, and that from many points of view the most appropriate site for such an instrument is on the high veld in South Africa, where the American universities of Harvard, Yale, and Michigan, as well as the Smithsonian Institution, have already established observing stations, and where the University of Leyden is also to have an observatory through a grant of £20,000 from the Rockefeller Institute.

There should be no difficulty in arranging for a close relationship between the University of Oxford

and the Radcliffe Observatory wherever it may be. The University has an observatory of its own, and the professor of astronomy, Prof. H. H. Turner, strongly advocates the proposed removal of the Radcliffe Observatory to South Africa. Such an outpost where young English astronomers could go for experience, and to which the professors at Oxford might send students, would be most useful; and friendly co-operation of this kind between the University and the Radcliffe Observatory would be easy to establish. A good deal of the measurement of spectroscopic and other photographs could no doubt be carried on at Oxford, leaving the astronomers at the Observatory in South Africa free for observational work. Oxford has received so much from South Africa that it might now appropriately welcome the transfer to that country of an observatory which cannot usefully extend its work under present conditions, either of site or of instruments. Existing work would, of course, be continued before the removal took place. We understand that if and when the sale of this site is completed, the Radcliffe trustees will take a lease for five years of the observatory buildings and part of the grounds to enable the completion of the programme of work on the proper motions of faint stars in the Kapteyn selected areas (about 30,000 stars are involved) started by Rambaut twenty years ago. The actual observatory buildings would remain as a brilliant example of classical architecture; it is Sir William Morris's wish that they should be used for post-graduate work in connexion with the University School of Medicine.

Theoretical and Applied Colloid Chemistry.

(1) *Elektrochemie der Kolloide.* Von Prof. Dr. Wolfgang Pauli und Dr. Emerich Valkó. Pp. xii + 647. (Wien: Julius Springer, 1929.) 66 gold marks.

(2) *Die Kolloide in Biologie und Medizin.* Von Prof. Dr. H. Bechhold. Fünfte völlig umgearbeitete Auflage. Pp. xii + 586 + 7 Tafeln. (Dresden und Leipzig: Theodor Steinkopff, 1929.) 32 gold marks.

(3) *Équilibres superficiels des solutions colloïdales: études de biophysique moléculaire.* Par Dr. P. Lecomte du Noüy. (Monographies de l'Institut Pasteur.) Pp. 228. (Paris: Masson et Cie, 1929.) 32 francs.

(1) THIS imposing volume attempts, as the preface states, to base an electro-chemistry of colloids on the modern theories of electrolyte solutions. It is the outcome of careful investigations continued for many years, beginning with proteins and gradually extended to many inorganic sols.

The book falls into three main sections: an introduction, which is a concise summary of the relevant chapters of modern physical chemistry, a general and a special electro-chemistry of colloids. The second section, after describing the preparation and purification of sols as well as their coagulation by electrolytes, proceeds to develop the principal theses of Pauli's theory. Suspensions and colloid particles behave like electrolytes of very high molecular weight. The particle consists of a neutral portion forming its main bulk, composed of insoluble and non-dissociating molecules, and a small 'ionogenic' portion which is, generally speaking, a true complex compound in Werner's sense. The ionogenic complex dissociates into two sets of ions, one of which is held to the neutral portion by chemical forces and imparts the charge to it, while the other forms what Pauli calls the 'counter ions'. The particles may be 'isomolecular' when the neutral and the ionogenic part have the same composition, for example, in silicic acid:

$$[x(SiO_2 + nH_2O) \cdot yHSiO_3] + yH^+$$

or 'heteromolecular', when the two parts differ in composition, as in ferric hydroxide sol:

$$[x(Fe_2O_3 + nH_2O) + yFeOCl \cdot FeO^+] + Cl^-.$$

Pauli does full justice to the earlier work of J. Duclaux, who arrived at a somewhat similar 'chemical' theory by combining conductivity measurements with determinations of osmotic pressure. Pauli considers the latter liable to many errors and substituted for them electrometric measurements; he also investigated sols much more highly purified by prolonged dialysis, and especially by electrodialysis, than those studied by earlier workers. The record of this large mass of minutely careful quantitative work deserves the most careful study. To obtain complete insight into the constitution of the ionogenic complex, it is necessary to combine with the electrical methods chemical analysis, which also calls for a highly developed technique.

Even this complete armoury, however, fails in some cases. It is a little disappointing that it should do so with the gold sols which at first sight might seem ideal for testing the claims of Pauli's theory and its chief rival, the adsorption theory. The constitution of the ionogenic complex is not definitely known, but Pauli assumes it to be an aurate or auric acid, the anion of which gives the particle its negative charge. Zsigmondy and his school, on the other hand, consider that it is due

to the adsorption of OH ion. On either assumption the disperse phase should contain oxygen, but careful analyses of the coagulum by both parties has failed to find any. Pauli argues that the composition of the coagulum is not that of the stable particles, and that his view receives support from the analogy with hydroxide sols and more directly by recent work on platinum sols. Of the adsorption theory in general he says that it " cannot be considered more than a description ". Still, it seems difficult to account for the negative charge on the particles of ' pure oil-water ' emulsions otherwise than by the adsorption of OH ions, since no other anions are available.

The reviewer must confess to a slight feeling of disappointment—probably unreasonable—on reading the application of the authors' theory to the fundamental problem of the electrolyte coagulation of lyophobic sols. To attempt a theory of the stability of sols would, they say, be premature, as we have no theory of solubility, of which the stability of colloids is a special case. It looks as if the experimental fact that colloidal anions, that is, negatively charged particles, give a coagulum with all cations had to be accepted like the fact that electrolytic anions give precipitates with specific cations, for example, SO_4'' with $Ba^{\cdot\cdot}$. The adsorption theory put forward by Freundlich to account for the valency effect is rejected by the authors, without any very clear alternative, on two grounds: the empirical nature of the adsorption isotherm and the impossibility of proving that different ions are adsorbed to the same extent.

It must be confessed that these doubts as to the adequacy of the authors' theory to solve all the long-standing problems of colloid chemistry do not strike the reader until some time after he has finished studying their book. The first impression is profound, such as a vast generalisation naturally produces on the student of a subject which has, perhaps, led a somewhat hand-to-mouth existence in the way of theory; a generalisation, moreover, supported by a vast array of experimental work, the implications of which are developed and argued with extreme acuteness. Sometimes, indeed, the authors go beyond what the facts seem to warrant, as in a notable passage (p. 296) headed: " The Validity of Faraday's Law ", and beginning: " Faraday's law of equivalent separation naturally holds for the electrolysis of colloidal electrolytes too, provided it is referred to the products separating at the electrodes or escaping as gas. On the other hand, it does not necessarily hold for the gel which separates." If the reader, quite reasonably, hopes for even a few instances which permit quantitative verification of the law and would thus provide the most striking evidence possible for the theory, he is doomed to disappointment, since a very detailed discussion of the secondary effects leads to the conclusion that a quantitative verification is scarcely to be expected.

Whatever the quantitative evidence, however, it will in the end probably depend on the reader's bias whether he considers that a great attempt to develop a single theory of the constitution of aqueous sols, which excludes adsorption even as an ancillary factor, has succeeded or, indeed, can be completely successful. It is certain that everyone seriously interested in the subject will have to study this book, which puts the case for the ' purely chemical ' view with extraordinary ability and, where it becomes controversial, with perfect fairness and good temper.

(2) The second edition of Bechhold's well-known work appeared in 1918 and was twice reprinted without alterations. The present, fifth, edition has been entirely re-written, a course which has become unavoidable in view of its purpose, " to apply the results of the investigation of colloids to biology ", and the enormous amount of new work done in this field in the last ten years.

A short introduction to colloid chemistry forms the first part of the book. The second, headed " Biocolloids ", deals first with the colloidal constituents of organisms—the carbohydrates, lipoids, and proteins—and then with foods and drinks, enzymes and immunity reactions, giving a clear survey of these subjects in some 80 pages.

The third part is probably the most interesting, certainly to the reader who is a student of colloids rather than of biology. Assuming what nobody will contest, that living organisms must be built up from colloidal material, the author goes on to say that " Colloid and water in the organism are *one*; an organism free from water is lifeless ". It is indeed in this point, the retention, distribution, and elimination of water by organisms, that colloid chemistry has contributed most materially to the elucidation of biological problems. It is not necessary to recall how the theory of osmotic pressure was hailed, and even largely developed, by biologists, and how soon it failed to explain things such as—to take one example out of many—the rapid death of marine organisms in pure sodium chloride solutions isotonic with sea water. We now know that the water content of organisms or of living tissues is not regulated merely, or even largely, by osmotic equilibria, but also by the specific effects of ions,

effects which manifest themselves equally in the swelling of non-living and structureless material like gelatin, and have been investigated largely by this means.

How far-reaching are the applications of these experimental results is shown by a very large number of examples under the sub-headings: distribution of materials and metabolism; growth, form and development; cells and tissues; respiration and circulation; resorption, secretion and excretion, and nerves. Notwithstanding the large amount of literature drawn upon, the author is not content to give abstracts but always preserves a critical attitude. The reviewer (with recollections of papers on "The Viscosity of Protoplasm" in his mind) is entirely in sympathy with the author's strictures on the use of the term to describe the contents of any cell, and with his comment: "In looking for the *common* properties of the different protoplasms, one substitutes a uniformity which certainly does not exist, and overlooks the differences".

The fourth and last part is devoted to toxicology, pharmacology, and therapy, and to microscopic technique. Among many other interesting subjects it discusses the therapeutic effects of colloidal metals, which still seem to lack a complete explanation. The chapter on microscopic technique gives a good survey of the present theories of staining with due reference to the work of the Prague school.

An unusually complete name index and an adequate subject-matter index add to the value of the book. It should have a stimulating effect on colloid chemists and provide those who have ambitions beyond further investigations on the coagulation of gold or arsenic trisulphide sols with a vast number of fascinating problems.

(3) This is a practically unaltered translation of a work published in English under the same title in 1926 and reviewed in NATURE of April 9, 1927, vol. 119, p. 523. E. H.

Buckman's Type Ammonites.

Type Ammonites-VII. By the late S. S. Buckman. With Editorial Note, Chronological and other Tables and Index, by Dr. A. Morley Davies. Parts 71-72 (combined). Pp. 15-78. (London: Thomas Murby and Co., 1930.) 20*s*.

THE death of S. S. Buckman has brought to a stop, though not to an end, one of his most remarkable works—those descriptions and figures of Jurassic ammonites, normally from English localities, which began in December 1909 under the title "Yorkshire Type Ammonites" and continued after the War as "Type Ammonites". To how many volumes the series might have extended it is impossible to calculate, so embarrassingly rich is the Jurassic ammonite fauna, and so keen was the discrimination of the author. Actually the seventh volume was in progress, and it is now completed by a double part, for which sincere thanks are due to Prof. A. Morley Davies and his coadjutors, Dr. Spath, Dr. Trueman, and also Mr. Tutcher, who has all along been mainly responsible for the excellent photographs. They have performed a laborious task as a memorial to one who throughout his life was a single-hearted student of Nature.

Both format and form of the work were suggested by *Palaeontologia Universalis*, of which it was originally intended to form part. In that work, produced by D. P. Oehlert and a committee of the International Geological Congress, the essential features were to be a plate referring to each species and bearing a photograph of the type-specimen and a reproduction of the original figure, with an accompanying page reprinting the original description and adding such brief notes as might seem necessary. Buckman, turning to the type-specimens of Young & Bird and Simpson in the Whitby Museum, soon found that more information and discussion were necessary, and rightly judged it more convenient to issue his plates as an independent series. As the work progressed, changes were introduced in the method of description, important discussions and occasional excursus found their way into the text, new material involved corrections, and, in short, neither the simplicity nor the original plan could be maintained.

Prof. Morley Davies, therefore, to bring the work to a decent cessation, has here provided a guide to its 1051 plates and its 797 species. He has arranged the names of the latter in the order of stratigraphical succession, under hemeræ, and he suggests that the plates might be arranged in a like order, and divided into six volumes. The letterpress, with five portraits, would form a seventh volume. This list is followed by a list of the plates in numerical order with references to the hemeræ.

Then follow an alphabetical list of the 407 genera, with references to plate, page, and horizon; an alphabetic list of trivial names, with references to genus, plate, and hemera; a list of names altered during publication, which, the cynics may be

surprised to learn, amount to only 4·6 per cent; a list of new names appearing first in the text; and an index to ages and hemeræ. These and many other notes will make this part indispensable to every user of the work, and subscribers should apply for it without delay.

Fresh-water Biology.

Life in Inland Waters: with Especial Reference to Animals. By Kathleen E. Carpenter. (Text-Books of Animal Biology.) Pp. xviii + 267 + 12 plates. (London: Sidgwick and Jackson, Ltd., 1928.) 12*s.* net.

AN introductory work on modern aims and methods in the study of fresh-water life was much wanted, and this book is exactly fitted for the purpose. It forms one of the well-known and useful series of Text-Books of Animal Biology edited by Prof. Julian S. Huxley, who contributes an introduction to this volume. The chief object set before the worker is to study the life in inland waters by finding out all that there is to know, not only about the animals themselves and their inter-relations with other animals and with plants, but also all that there is to be known about the waters which they inhabit, their physical and chemical nature, geological features, past and present, and how they affect the organisms — in fact, to study the animal thoroughly in relation to its environment.

It is often said that life in fresh water has been neglected because of the more attractive life on the sea-shore which is nowadays accessible to almost everyone; but a large amount of excellent and important work has accumulated recently in connexion with fresh-water biology, and there is a good foundation laid for research in many fields. It is no longer considered sufficient to identify the animals one finds; one must know everything of the life as a whole in each individual area. Dr. Carpenter is a good field zoologist and her own work has led her to study her subject in this way; therefore she is able to show what is wanted. She has produced a real natural history book, attractive and interesting, which will be of much use to all students, supplementing the ordinary text-books and courses of study. Much that is brought together here can be found only by diligent search in the papers of specialists. The bibliographies placed at the end of each chapter are well chosen and contain most of the more important works to be consulted.

Perhaps the best parts of the book are the chapters dealing with the biology of streams, rivers, and lakes. Here the author is completely at home and the descriptions of the relations and reactions in all groups to so many different habitats make a most interesting whole. Fresh-water animals are peculiar in offering an enormous number of examples in adaptation, having to withstand numerous and various vicissitudes such as drought, torrents, and differences in physical and chemical constitution of the water in which they live. Hence there are hard-coated eggs surviving after the death of the parent to burst out into life when better seasons come, or special adaptations for lying dormant either in winter or in summer, special ways of living in rushing streams by clinging tightly to rocks and stones and wonderfully devised apparatus for hanging to the surface film. It is peculiarly with insects that such adaptations are at their height and the entomologist has much work before him. In spite of all the splendid pioneer work of the older naturalists, whose work still stands as the model of what such work should be, the present-day naturalist has not far to go to find a suitable problem for research. He has only to inspect the nearest piece of water, however small, and he will probably find in it some insect the life-history of which is unknown. A complete survey of the tiniest pond in all its aspects throughout a year can easily occupy many years of work.

Apart from the discussions on the dependence of animals on plants as food, the description of the plant life is purposely reduced to a minimum. A few plants are, however, mentioned, particularly those in the plankton. We should like to know what the author understands by a Peridinian. The terms Peridinians and Dinoflagellates are usually regarded as synonymous, but on p. 32 we read "Dinoflagellates and Peridinians", and again on p. 203, "*Ceratium hirundinella* . . . gives place to . . . and Peridinians", although on p. 197 *Ceratium*, *Glenodinium*, and *Peridinium* are given as Dinoflagellates.

The last chapter treats of the biology of inland waters in relation to human life, and includes discussions on river pollution, a subject in which the author has herself done good work and which is of ever-growing importance.

The illustrations are good, consisting of photographs and clear diagrammatic drawings, the latter perhaps suffering slightly from the roughness of the paper on which they are reproduced. This book is recommended heartily to all interested in the biology of inland waters.

Our Bookshelf.

The Psychological Register. Edited by Carl Murchison, in co-operation with F. C. Bartlett, Stefan Blachowski, Karl Bühler, Sante De Sanctis, Thorleif G. Hegge, Matataro Matsumoto, Henri Piéron, A. L. Schniermann. (The International University Series in Psychology.) Pp. ix + 580. (Worcester, Mass.: Clark University Press; London: Oxford University Press, 1929.) 27*s.* net.

THE difficulties in compiling a "Who's Who" of any kind are twofold: first, to decide who shall be included; and secondly, to obtain accurate entries. The second difficulty is overcome to a large extent by obtaining particulars directly from the individuals concerned, but, as Prof. Murchison remarks in his preface, it is not easy to surmount the language obstacle in dealing with a work which has to cover the whole world. The first difficulty, however, is more serious. In the volume before us, all full members, and also all associate members with Ph.D. degrees, of the American Psychological Association, which has high technical requirements for admission, are included. For other countries Prof. Murchison has had to depend on the nominations of the members of his editorial board; thus Dr. F. C. Bartlett has acted for the British Empire, Dr. H. Piéron for Latin countries outside Italy, and Dr. Z. Y. Kuo and Dr. E. Shen have furnished Chinese names.

The result of this method of selection—and it is not easy to see how it could have been improved—is that the American entries occupy 296 pages of the book. This is, perhaps, not so disproportionate as may seem when the volume of work on psychology carried out in the United States is considered. However, the editor is of opinion that other countries are not adequately represented, partly on account of the fact that workers in psychology are often 'labelled' as physiologists, psychiatrists, philosophers, and educationists, and he appeals for additional names in order to make the book truly international in scope.

The details given include name, address, date of birth, education and career, and titles of papers (with bibliographies) and published works. The entries are arranged alphabetically under countries and there is a name index.

Algebraic Geometry and Theta Functions. By Prof. Arthur B. Coble. (American Mathematical Society Colloquium Publications, Vol. 10.) Pp. vii + 282. (New York: American Mathematical Society; Cambridge: Bowes and Bowes; Berlin: Hirschwaldsche Buchhandlung, 1929.) 3 dollars.

IN discussing algebraic curves and surfaces we have the choice of several distinct methods. Some authors rely upon Cremona transformations, by which the curve or surface is brought into correspondence with another and simpler curve or surface. Others rely upon invariant theory, reducing the geometry to algebra. A third school uses parametric representation. It is well known how easily the properties of conics are derived by expressing the co-ordinates of their points as rational or trigonometrical functions of a parameter. For certain cubics, we use elliptic (that is, doubly-periodic) functions. When we come to curves of higher orders we need theta functions, which are multiply-periodic. Some complications arise from the fact that such functions necessarily involve more than one parameter, and are connected by a large number of complicated equations.

The special merit of Prof. Coble's treatment is that he brings all these various methods into relationship with one another. In particular he correlates his own researches, developed by means of Cremona transformations, with those of Schottky, who uses the theta functions as a starting-point. There are also references to apolarity and a few of the simplest ideas of the theory of groups. No thorough treatment of advanced algebraic geometry can be easy reading, but Prof. Coble has done as much as possible to smooth our path.

H. T. H. P.

Dipolmoment und chemische Struktur. Herausgegeben von Prof. Dr. P. Debye. (Leipziger Vorträge, 1929.) Pp. vii + 134. (Leipzig: S. Hirzel, 1929.) 9 gold marks.

REVIEWS have recently appeared in these columns (NATURE, Jan. 4, p. 9) of Prof. Debye's book on polar molecules, and of a translation of this work into German, which has the additional merit of including an up-to-date list of values of this important constant. The present volume deals with the same topic, and has been compiled under the inspiration of the same author; but it has taken a different form, since it includes within its covers thirteen contributions by nine authors in reference to dipole moment and chemical structure. One of the contributions (from an American worker in Brussels) is in English; the remainder are in German, but include papers from laboratories in Zurich and Copenhagen, as well as Hamburg, Würzburg, Freiburg, Karlsruhe, and Leipzig. The volume will be read with interest by those who are in a position to make use of one of the most important methods of deducing the structure of molecules from their physical properties.

Vorgeschichtliches Leben in den Alpen. Von Leonhard Franz. Pp. 95 + 23 Tafeln. (Wien: Anton Schroll und Co., 1929.). 6*s.*

THIS book, the author explains, has been written for lovers of antiquity and lovers of the Alps. It is a popularly written account of the prehistory of Switzerland from the earliest times of which traces have been found—"Die Zeit der Bärenjäger", as the author puts it—down to the end of the iron age. While it is intended primarily to interest the visitor to the country in its prehistoric antiquities, it will be found a convenient summary of information scattered in various publications. The lake villages naturally are treated in some detail. The book is illustrated by 82 well-selected photographs and drawings.

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 Radcliffe Observatory.

I HAVE been requested by the National Committee for Astronomy to forward the accompanying copy of a resolution adopted *nem. con.* by the Committee at a meeting held on May 9:

"In view of the large number of astronomical observatories already existing in the northern hemisphere in indifferent climates, where many important types of observational work cannot usefully be attempted;

"And in view of the great need for comprehensive investigations in the southern hemisphere with powerful equipment;

"And in view of the stations in the southern hemisphere already erected, or in course of erection, by several foreign observatories;

"And fearing the danger of British observational astronomy permanently losing its position in the front rank unless greater use is made of the best climates in the British Empire;

"The National Committee for Astronomy is of opinion that the establishment in South Africa, under English control, of a new observatory equipped with a large reflector, and adequately endowed, would not only be in the best interests of astronomy, but is almost an imperative necessity in the interests of British scientific prestige.

"Such an observatory, if established, would be able to carry out work in the southern hemisphere complementary to that of the Dominion Astrophysical Observatory in British Columbia, which has so signally justified its erection.

"Further, the Committee, being aware of the proposed transfer of the Radcliffe Observatory from its present site, is strongly of the opinion that the opportunity should be taken to move the observatory to South Africa rather than to another site in England, and that such a project would be an enterprise of national importance.

"The Committee feels confident that if this scheme were adopted, not only would new fields be opened up, but existing facilities would be greatly improved, in particular by co-operation between the Oxford University Observatory and the Radcliffe Observatory; and that this co-operation would be of much greater value to the study of astronomy in Oxford if the Radcliffe Observatory were transferred to a site in South Africa than if it remained in England."

Of the seventeen members of the Committee who were present when the vote was taken, the following voted in favour of the resolution:

A. Fowler (Chairman), Yarrow research professor of the Royal Society and professor of astrophysics in the University of London (Imperial College); A. C. D. Crommelin, president of the Royal Astronomical Society; C. R. Davidson, Royal Observatory, Greenwich; Sir Frank Dyson, Astronomer Royal; A. S. Eddington, Plumian professor of astronomy, University of Cambridge; J. Evershed, lately director, Kodaikanal and Madras Observatories; J. Jackson, chief assistant, Royal Observatory, Greenwich; H. Knox Shaw, director of the Radcliffe Observatory, Oxford; W. J. S. Lockyer, director of the Norman Lockyer Observatory, Sidmouth; E. A. Milne, professor of mathematics, University of Oxford; H. F. Newall, lately professor of astrophysics and director of the Solar Physics Observatory, University of Cambridge; Rev. T. E. R. Phillips, lately president of the Royal Astronomical Society; Lord Rayleigh, emeritus professor of physics, Imperial College of Science and Technology; R. A. Sampson, Astronomer Royal for Scotland; F. J. M. Stratton, professor of astrophysics and director of the Solar Physics Observatory, University of Cambridge; H. H. Turner, Savilian professor of astronomy, University of Oxford.

A. FOWLER
(Chairman of National Committee for Astronomy).
Imperial College of Science and Technology,
London, S.W.7, May 16.

Quantitative Analysis by X-Rays.

IN their interesting letter to NATURE of April 5, p. 524, Prof. T. H. Laby and Mr. C. E. Eddy agree with many of the statements in my address to the British Association, but dissent in some respects from my conclusions. According to their view, I was not sufficiently generous in stating the sensitiveness of the method. The sensitiveness depends on numerous factors such as the energy applied, the time of exposure, the wave-lengths to be photographed, and so on, and in a very high degree on the constitution of the sample; traces of copper present in aluminium will give an X-ray line incomparably stronger than when present in the same atomic concentration in lead. The state of aggregation of the sample is also of great importance; an alloy available in comparatively large amounts, which can be soldered massively on to the anticathode, and, on account of its high heat and electrical conductivity, can be bombarded very intensively by cathode rays, is much better than a sample of mineral possibly available in minute quantity only, which must be rubbed as a powder into the anticathode.

As the sensitiveness is to a high degree dependent on the conditions mentioned, no exact figure covering all cases can be quoted; the determination of an element present to the extent of 1 in 10,000 is possible in many cases, and in some special ones lower concentrations still can be determined. Prof. Laby and Mr. Eddy achieved much greater sensitiveness in their analyses than this, and they are to be congratulated on the excellent results they obtained in the analysis of copper or iron in zinc. I must, however, entirely disagree with their statement that the entire X-ray spectrum of an element can be obtained even at concentrations less than 0·0001 per cent. If they try to determine traces of sodium in lead they will certainly encounter very great difficulties even at so high a concentration as 1 in 10,000, and if they try to analyse most mineral samples, they will scarcely be able to attain the accuracy claimed.

As the intensity of an X-ray line is closely dependent on the constitution of the sample, it cannot be considered an exact measure of the amount of the element present; but if a suitable reference substance be added to the sample and the assumption made that the line emitted by the latter is influenced by the presence of different elements in exactly the same way as the line of the element to be determined, then a comparison of the intensities of the two lines can be employed as a method of quantitative analysis. It is only necessary to know the amount of the reference substance added and the intensity ratio of the two lines emitted by equal numbers of atoms of the two elements, which can be empirically determined.

While it is convenient to compare lines of equal intensity, partly because a microphotometer is then no longer essential and partly because some of the

disturbing effects are minimised, the method is in no way restricted to these cases. In some very special cases an addition of reference substance is not necessary as it is already contained in the sample to be investigated and such special cases were investigated by Prof. Laby and Mr. Eddy, but this method is of very restricted application and will fail in the whole domain of mineral analysis, and also in many cases of the analysis of alloys. The chief field of quantitative X-ray spectroscopy, however, is not those alloys which can easily be analysed by chemical methods, but the large domain of mineral analysis where the tedious processes used to dissolve the mineral can be avoided and the great difficulties with elements like niobium, tantalum, and the rare earths, and so on, can be circumvented. So far as alloys are concerned, cases like the determination of traces of tungsten in steel or of iridium in platinum might be included.

The success of the analysis depends greatly on the suitable choice of the reference substance. As mentioned above, we have to assume that the line emitted by the reference substance is influenced in exactly the same way by other constituents of the sample as the line to be investigated. If the reference substance is not chosen accordingly, this condition is far from being fulfilled. When determining chromium ($K\alpha_1$ 2285 X.U.) the praseodymium $L\beta_1$ line (2254 X.U.) is a suitable reference line; but should comparatively large amounts of vanadium be present, the analysis will give a wrong result, as the absorption edge of vanadium (2265 X.U.) is situated between the two above-mentioned wave-lengths and as only praseodymium can excite the K-spectrum of vanadium, a selective weakening of the praseodymium line will take place. It was found that the presence of 4 atoms of vanadium to each atom of praseodymium alters the intensity ratio by 63 per cent.

When nickel is compared with cobalt in the presence of a large excess of copper, the intensity ratio of the nickel and cobalt lines will be shifted in favour of the cobalt line, as only the cobalt edge can be excited by the copper lines. We have here a case of another group of disturbing effects, namely, where strong emission lines of elements present in large amounts are situated between the absorption edge of the element to be determined and the absorption edge of the reference line. In a paper in print for the *Zeitschrift für Physik*, a complete list of reference substances is given for all elements between sodium and uranium and the limitations in each case.

Apart from the disturbances mentioned above, an entirely different kind of disturbance can originate from the fact that under the influence of the cathode rays a change in the composition of the mixture takes place. When investigating a mixture of refractory oxides these disturbances are scarcely noticed. Nor have such been noticed by Prof. Laby and Mr. Eddy when analysing alloys—their alloys being soldered to the anticathode and having high conductivity for heat and electricity, this can easily be understood. But when analysing minerals or chemical compounds, especially those containing components of fairly high vapour tension, very appreciable errors can be introduced. To avoid these errors (which were first systematically investigated by Coster and Nishina, and whose work was corroborated and extended by Glocker and Schreiber), it is advisable in such cases to abandon the excitation of the X-ray spectra by cathode rays and to excite them instead by X-rays and investigate the secondary X-ray spectrum.

While in special cases such as the one so successfully investigated by Prof. Laby and Mr. Eddy, methods can be developed where the addition of a reference substance can be dispensed with, only those in which an added reference substance is employed can claim general applicability.

G. HEVESY.

Physikalisch-chemisches Institut,
Freiburg im Breisgau,
April 26.

Fine Structure of K-Absorption Limit of Silicon Oxide.

THAT the X-ray absorption limits are not simple but show a rather complicated structure has been known now for some time. The main difficulties in their experimental investigation are in respect of (1) amount of the absorbing substance, and (2) dispersion of the spectrograph. The amount of the absorber must not be either too great or too small, otherwise the details are lost. Secondly, the dispersion must be made as large as possible to bring out all the details and measure them with the usual accuracy.

Fricke investigated K-absorption limits of some of the lighter elements (*Phys. Rev.*, **16**, 1920). He could not get any absorption limit at all for silicon. This was probably due to his using very thick absorbing screens coupled with the low dispersion which he obtained with sugar crystal. Later Lindh (*Zeit. für Phys.*, **31**, 1925) succeeded in obtaining the K-absorption limit for silicon both pure and in chemical combination ; but no fine structure was seen in any case.

Recently in this laboratory I made an attempt to obtain fine structure of the K-absorption limit for silicon oxide without the use of an extra absorbing screen, the analysing quartz crystal itself acting as the absorber. This was done at the suggestion of Prof. Siegbahn, to whom I am highly indebted for it. The vacuum spectrograph used was one of the latest models of Prof. Siegbahn's design made in the laboratory workshop. The continuous radiation was obtained with tungsten as the anticathode material. The tension at which the X-ray tube was worked was kept suitably low and the current density was pushed up as much as possible. The rather long exposures of twenty to twenty-four hours were amply

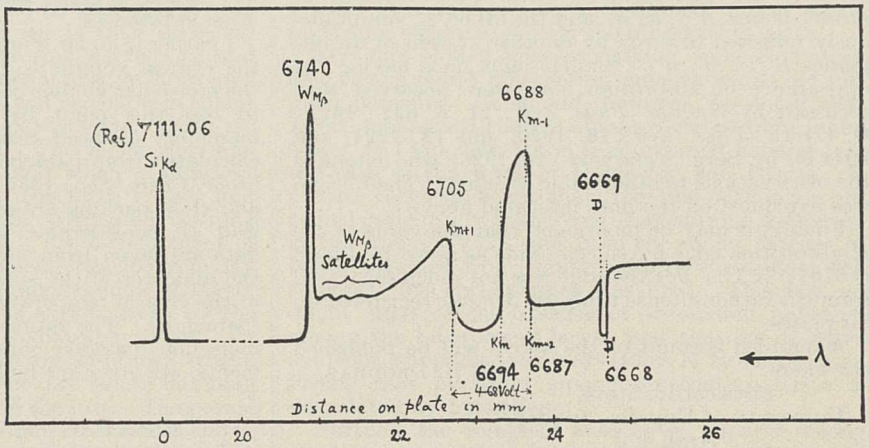

FIG. 1.

repaid by the extended fine structure of the K-limit of quartz recorded on the plate. The blackening of the photographic plate is shown diagrammatically in Fig. 1, which also gives the wave-lengths in X.U. of the several edges.

It is interesting to note that the white line between D and D' is only 0·054 mm. wide, while the width of the slit was 0·091 mm. Still farther to the right of DD' there are two more such lines. As, however, owing to feeble intensity, their measurement is uncertain, they are not shown in the diagram. From the nature of these lines it appears that they are not components of the K-absorption of silicon oxide: an explanation of them must be sought in the geometry of the atomic planes of the quartz crystal. The discontinuity at DD' recorded on the photographic plate arises, as Fig. 2 shows, in the process of division

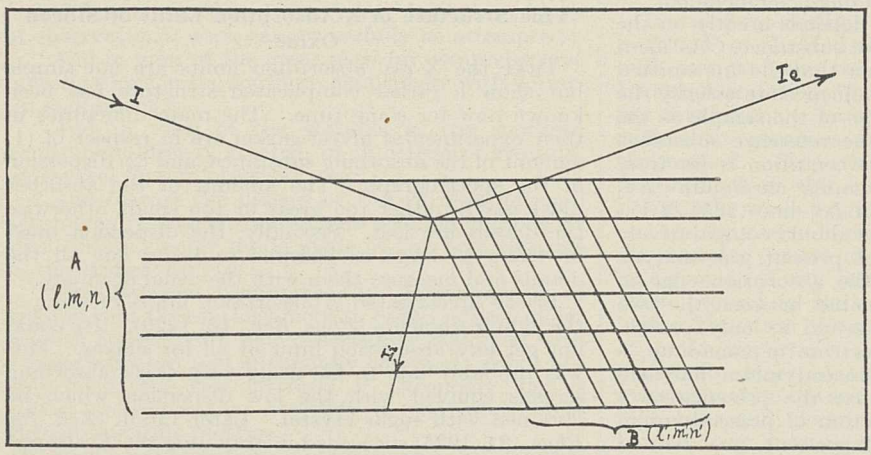

FIG. 2.

of the incident energy I corresponding to wave-length λ into two parts, one, I_e, regularly reflected towards the photographic plate by a system of atomic planes A (l, m, n), and the other, I_i, simultaneously reflected inwards by another system of atomic planes B (l', m', n'). Similar light lines having the appearance of absorption lines were observed with rock-salt by Wagner (*Phys. Zeit.*, **21**, p. 632; 1921), O. Overn (*Phys. Rev.*, **16**, 1920, and **18**, 1921) and later on by Berg (*Naturwiss.*, **14**, 1926), who extended the observations to other cubic crystals. Their origin was explained on the lines indicated above.

Finally, it may be mentioned that the value of the K-absorption edge for silicon oxide as given by Lindh is 6707·5 X.U.; but the edge was not much separated from the rather intense tungsten $M\beta$ line registered on his plates.

A detailed account of the above will be published elsewhere.

G. B. DEODHAR.

Physical Institute,
University of Uppsala, Sweden,
April 4.

The Parachor and Molecular Volume.

DR. FERGUSON'S letter in NATURE of April 19 is a little difficult to follow. At first he agrees with me that the parachor is a comparative measure of molecular volume "at temperatures such that the surface tensions are equal", yet later he says emphatically that "it is certain that the parachor is not a molecular volume".

It is evident that the term "molecular volume" must here be used in two different senses. The most direct significance of this expression is the actual volume of N molecules (where N is Avogadro's number). Our knowledge of the dimensions of molecules is, however, very limited and is mainly based on collision areas deduced from gas viscosities; to convert these into volumes involves hypotheses concerning the shape of the molecule and thus introduces large uncertainties. From the time of Kopp it has been assumed, implicitly, or explicitly, by many writers that the volume *occupied* by a gram molecule of the substance in the liquid or solid state under some standard condition is a measure of the volume of the molecule. Comparisons of such molecular volumes have been made for the volumes occupied at absolute zero, at 0° C., at the boiling-point, and at the critical temperature; hence when I used Macleod's equation to calculate the volumes occupied by liquids at constant surface tension I did not (and still do not) consider it unjustifiable to regard the result as a measure of molecular volume.

The relation between the parachor and the critical volume was never put forward as an accurate physical law but as a rough test of the view expressed above. Dr. Ferguson's relation is undoubtedly more accurate; it is interesting to note, however, that as the complexity of the molecule increases, V_c and θ_c increase together in such a way that the ratio $V_c^{1/6}/\theta_c^{1/4}$ involving small fractional powers of these quantities is nearly constant. Hence except for hydrogen and helium both my relation and Dr. Ferguson's hold with fair accuracy. I am indebted to Dr. Ferguson for correcting my blunder with regard to the critical volume of hydrogen; both this gas and helium give a ratio of P/V_c which is much smaller than that given by most other substances.

I gather from Dr. Ferguson's letter that he considers the critical volume to be the most significant of all the molecular volume constants. I have endeavoured to test this point by a comparison of molecular diameters deduced from gas viscosities with those calculated from parachors and from critical volumes. (*Jour. Chem. Soc.*, 1055; 1929). Spherical molecules and close packing are assumed and these hypotheses lead to considerable uncertainties. The following data are taken from this paper. σ_c and σ_p represent the diameter of the sphere occupied by the molecule at the critical temperature and at unit surface tension (parachor). The ratios of these quantities to σ_η, the molecular diameter obtained from viscosity measurements, are given in the last two columns.

Substance.	σ_η.	σ_p.	σ_c.	σ_p/σ_η.	σ_c/σ_η.
Hydrogen	2·18	4·34	5·33	1·99	2·44
Helium	1·94	3·61	5·12	1·86	2·64
Neon	2·32	3·88	4·60	1·67	1·98
Argon	2·90	5·01	5·73	1·73	1·97
Chlorine	2·18	6·38	6·61	1·55	1·60
Bromine	4·12	6·75	6·81	1·67	1·69
Hydrogen chloride	4·04	5·41	5·93	1·85	2·02
Benzene	4·20	7·84	8·42	1·87	2·01
Propyl Acetate	4·67	8·42	9·31	1·80	1·99

It will be seen that the critical volumes of helium and hydrogen give abnormally high values for the ratio σ_c/σ_η, whilst the ratio σ_p/σ_η based on the parachor for these substances is more nearly in agreement with

that found for more complex molecules. This may be due to the unusually large forces between the molecules of hydrogen and helium due to the presence of two electrons only in the outer shell; in most other substances the outer shell of each atom contains eight electrons and the intermolecular forces are correspondingly modified. Hence the parachor, in which some attempt is made to allow for the effect of internal pressure on the volume occupied by a gram-molecule of a liquid gives a rather better parallelism with the viscosity data than does the critical volume. The uncertainties involved in the data and in the hypotheses used in the calculation of diameters are large and must be borne in mind when attempting to interpret the ratios given in the last column of the table. The abnormality of the critical volumes of hydrogen and helium is, however, so great that I think it must be regarded as real.

S. SUGDEN.

Birkbeck College,
London, E.C.4.

A Method of obtaining Stages in the Life-history of the Liver Fluke for Class Purposes.

THE life-history of the liver fluke (*Fasciola hepatica*) was described by A. P. Thomas in *Q.J.M.S.*, Lond., vol. 23, N.S., 1883. He succeeded in rearing experimentally the early stages of the complicated life-history of this parasite by collecting eggs from the gall bladder of sheep, bringing about their hatching under suitable conditions, and infecting the molluscan host, *Limnæus truncatulus*, from which he obtained both rediæ and cercariæ, using the latter for the infection of young lambs. His methods, however, are not suitable for class demonstration owing to the difficulty nowadays of getting the eggs of the fluke from heavily infected sheep.

During the past two years I have used a simpler method. It is generally possible to obtain from the local abattoir a few specimens of adult flukes either alive or dead. The flukes should be washed free from bile and mucus. Each specimen is then dissected under the Zeiss binocular dissecting microscope and the contents of the uterus emptied into a flat-bottomed watch glass. Some of the eggs will be yellow in colour and are suitable for hatching experiments, others are white and should be discarded. The yellow eggs sink to the bottom of the water, and when a sufficient number have been extracted, the fluke tissues and clouded water are pipetted off. Repeated washing leaves the eggs in a clear fluid. The development of the eggs can be studied under the microscope from day to day. Every few days the water should be changed. Warning of the hatching of the eggs is given by the appearance of cilia and of the X-shaped eye spot. At first the young embryo squirms up and down within the egg shell, but about the last day before hatching it turns round as if trying to find the exit. The period of development varies with the temperature; in spring it is about a month, but is less in warmer weather. The eggs hatch in batches in the morning and the larvæ are phototropic. By the same evening all are dead unless they have found a host.

As soon as possible after hatching, a specimen of *Limnæus truncatulus* is introduced into the dish. In a short time it acts as a focus around which the miracidia swarm. The actual penetration can be watched under the Zeiss binocular. Large numbers of the larvæ fix themselves to the tentacles, head, and mantle of the snail, so that the unfortunate and apparently unconscious mollusc is bristling with white threads, which show up well against its dark skin. As many as sixty were counted on one snail, and this does not include those which entered the pulmonary chamber and were lost to view. The larvæ bore like screws, and take from fifteen minutes to an hour or more to disappear within the snail.

Specimens of *Limnæus* preserved at this period and afterwards sectioned show the miracidia entering the body, while snails killed after an interval of two or three weeks exhibit the sporocyst and redia stages. Many of the miracidia do not develop; Thomas says they must enter the pulmonary chamber or body cavity and that they do not develop in the foot. I have, however, found them in the kidney, dorsal body wall of the head and sides of the foot. Thomas also states that few snails survive three weeks of artificial infection, but I have had no deaths as the result of infection, however heavy. Snails were infected this year on Mar. 11, and are still alive and active.

N. B. EALES.

Zoology Department,
University of Reading,
May 3.

Parasitism in Relation to Pupation in *Lucilia sericata* Meig.

IN NATURE of April 19, p. 598, Holdaway and Evans make reference to the stage in which the hibernation of *Lucilia sericata* Meig. takes place. Their observations show that although "both larvæ and puparia were recovered from the soil surrounding baits exposed in the autumn and examined towards the end of the season", that 87·4 to 92·2 per cent of these puparia (plus larvæ pupated within eight days of collection) were parasitised. From these facts it is evident that in Toulouse, France, from which station the letter is addressed, the normal mode of hibernation of *Lucilia sericata, excluding the influence of parasitism*, is in the larval stage, and thus is similar to that found by me in North Wales in 1928–1929 (NATURE, May 18, 1929, vol. 123, p. 759). In the latter case, and again last winter, when observations on the hibernation of *Lucilia sericata* have been confirmed, not a single puparium appeared among the hibernating larvæ.

This fact at first appears striking, since Holdaway and Evans found hibernating puparia which did not yield parasites. It should, however, be noted that I was dealing with larvæ obtained direct from living sheep, and not with larvæ from exposed baits as was the case in the work of Holdaway and Evans. It proved very significant that from the 5622 larvæ obtained periodically from living sheep during the survey in the summer 1928, and from the many batches of larvæ obtained from similar sources throughout the summer 1929, no parasite was bred. This fact no doubt explains the absence of stimulated pupation among the hibernating larvæ, and thus, as negative evidence, supports the observations of Holdaway and Evans that pupation among hibernating larvæ is stimulated by parasitism.

Further, the complete absence of puparia among these non-parasitised hibernating larvæ upholds the view that in the observations of Holdaway and Evans the puparia present which did not yield parasites had been previously stimulated to pupate by a secretion or other factor operative during the oviposition of the parasite, which oviposition had been non-productive.

The absence, or the extraordinary rare occurrence, of parasitism among larvæ of *Lucilia sericata* obtained from the living host will, no doubt, prove an important factor in the success of *Alysia manducator* Panz. in the biological control of blow-flies. The living sheep will obviously be a constant and important source of unparasitised larvæ. The reason for this immunity cannot be the absence of the parasite from the

localities from which the larvæ were obtained for specimens of *Alysia manducator* have been observed in quantity near carrion in several districts in North Wales. On the other hand, it is well known that the primary attraction of this parasite is the chemotropic action of carrion, hence it would appear that a live sheep attacked by larvæ of *Lucilia sericata* offers no attraction for ovipositing females of *Alysia manducator*, and thus the larvæ in this environment escape the attacks of the parasite.

W. MALDWYN DAVIES.
University College of North Wales,
Bangor.

Coloured Glass as a Deterrent to House Flies.

LAST autumn we received an inquiry from Mr. L. Macqueen Douglas, of Newpark, Mid Calder, Midlothian, who asked us whether we had any data concerning the action of coloured glass on house flies. In his experience coloured class, especially blue, acted as a deterrent, and he was using it in the construction of abattoirs, etc. At that time we were unable to obtain any further information upon the subject. On the appearance in NATURE of April 5 of the letter from Messrs. Pilkington Bros., who stated that red and yellow are the best deterrents and that blue and green are not nearly so effective, I communicated these facts to Mr. Douglas. He replied stating that he had carried his experiments somewhat further, and that from his experience blue glass is to be preferred to yellow for two reasons. First, he found that the blue glass was completely effective in preventing the development of flies; and secondly, that the blue glass does not give an offensive look to the meat, while yellow glass gives it an unhealthy-looking colour which from a commercial point of view is highly objectionable.

I might add that Mr. Douglas's experience of abattoirs and their construction is very extensive.

A. D. BUCHANAN SMITH.
King's Buildings,
West Mains Road,
University of Edinburgh, May 1.

MESSRS. PILKINGTON BROS., in NATURE of April 5, raise an interesting point regarding house flies and their dislike of light of certain hues. The following observations, made during September of last year, may be of interest.

Two similar small rooms were roof-glazed, one with ordinary rolled-plate, the other with a proprietary heat-absorbing glass transmitting bluish-green light. Ventilators in the two rooms gave insects equal opportunities for ingress, but at the end of a fortnight the numbers of insects in the rooms were so obviously unequal that a count was made, with the following result:

Type of Insect.	Under Clear Glass.	Under Bluish-Green Glass.
Flies	19	8
Moths	4	1
Wasps	4	0
Spiders. . . .	3	0

It should be added that, during hot weather, the maximum air temperature in the room glazed with rolled-plate was usually 5° or 6° F. greater than that in the other room. There was also a marked deficiency of infra-red radiation beneath the bluish-green glass which may partly account for the results obtained.

H. E. BECKETT.
Building Research Station,
Watford.

Nutritive Value of Elm Tree Bark.

IN the water-meadows opposite my home in Chalfont St. Peter several elm trees were blown down by last winter's gales. The horses and cows grazing on these meadows spent much of their time in chewing off the bark of the boughs of the fallen trees, although there was abundant young grass growing on the meadows all through the last months of a mild winter.

Interested by this fact, I put two lots of seven mice, just weaned from well-fed, healthy mothers of known stock, on a diet of white bread and water, and to one lot I gave some elm tree twigs every few days. The mice gnawed the bark off the twigs. At the end of seven weeks these mice had gained 45 gm., while the control lot had gained only 22 gm. in weight. X-ray photographs showed no difference in the lines of ossification of the bones in the two lots, so that the bark was not eaten for the sake of vitamin D. This might be thought to be deficient in winter grass owing to the low intensity of the short ultra-violet rays of the sun. The fur of the mice which ate the bark had a sleaker appearance.

LEONARD HILL.

Ionisation in Nitrogen.

EXPERIMENTS on corona discharge in carefully purified nitrogen at low pressures show that the mobility of the negative carriers is much lower than that found for electrons by Townsend and Bailey (*Phil. Mag.*, December 1921), as is shown by the following table:

X/p	ωp	
From 10 to 40	$4{\cdot}4 \times 10^5$	Townsend and Bailey
25	$12{\cdot}9 \times 10^3$	Corona Experiments
20	$9{\cdot}0 \times 10^3$	,,
15	$5{\cdot}7 \times 10^3$	,,

X = electric force in volts per cm.
ω = mobility in cm. per sec. per volt per cm.

Since Townsend and Bailey's experiments show that electrons retain their high mobility for a considerable time, the carriers cannot all be electronic. The greatest possible proportion of electrons present varies approximately linearly from 0·025 when X_0/p (at the surface of the inner cylinder) is 350 to 0·012 when X_0/p is 200.

J. H. BRUCE.
Electrical Laboratory,
Oxford, April 23.

Undercurrents in the Strait of Gibraltar.

IN view of the lively discussion of the undercurrents in the Strait of Gibraltar during recent years, some observations made by H.M. Surveying Ship *Goldfinch* (Lieut.-Commander F. H. Walter) in 1905 with the Pilsbury Current Meter, where I was serving as Senior Assistant Surveyor, may be of interest. They were not published, since they were not taken under good conditions, but they are amply sufficient to show that at a position N. 53° W. (True), 7 miles from Cape Spartel, the current between the surface and 200 fathoms was easterly and weak; below 200 fathoms it began to turn to the west, and observations between 250 and 290 fathoms showed currents of more than 5 knots flowing nearly west True. It is hoped that it will be possible to publish the observations in full, shortly.

H. P. DOUGLAS
(Rear-Admiral, and
Hydrographer of the Navy).
Hydrographic Department,
Admiralty,
London, S.W.1,
April 17.

Josiah Wedgwood and his Influence on the English Pottery Industry.

By S. R. HIND.

IN order to understand the state of the pottery industry of Britain at the time Wedgwood took up his labours, it is necessary to go back to a period some forty years before his birth in 1730. At this time the products of the Staffordshire potteries consisted of heavy, coarse ware made of local clays in the form of platters, drinking and cooking-pots, butter-pots, and similar articles. These were crudely made, usually on the potter's wheel, ornamented in an elementary way, if at all, and glazed imperfectly by means of raw lead preparations such as galena.

One great exception, indicative of the change to come, must be made on behalf of the secret manufactory of the brothers Elers, natives of Nuremberg, who had come over from Amsterdam and developed a new kind of ware at Bradwell Wood, near Burslem. They manufactured a fine red stoneware out of carefully prepared local clay, the articles being lathe turned whilst partially dry, ornamented with applied designs of sharp outline, and finally salt glazed. These new methods ultimately became diffused in the neighbourhood, with some loss in effect for the time being, but an enormous stimulus to progress, by the efforts of the elder Astbury.

Astbury's use of washes of finer clays marked the beginning of a line of development which led to various forms of ornamentation, engobes, and glazes of composite and infinitely superior character. The uses of various lead compounds, feldspar, borax, and other glaze components began to be explored and their qualities modified by a preliminary fusion or fritting.

The advantages of flint in admixture with both bodies and glazes soon came into prominence. Its preparation by dry grinding, following calcination, led to many cases of what we know now as silicosis; this danger was reduced very markedly by a painter named Benson, who introduced the wet grinding process. Later improvements in the application of water and wind power and the use of mill runners of chert, a fairly pure form of silica, in place of granite, take us down to the early careers of Brindley and Wedgwood.

Other notable advances were in connexion with plaster of Paris moulds, the use of the red clay colour-trials of Thomas and John Wedgwood in controlling the firing of ovens, an increasing appreciation and importation of ball-clay and pipe-clay from the south of England, the use of the slip-kiln, and the introduction of biscuit firing (that is, separate firing of the body before application of the glaze) by Enoch Wood; this at a time when Wedgwood had already launched out in his early partnership with Harrison and Alders.

By this time, a coarse cream earthenware, white or greyish-white and red stoneware and tortoiseshell ware, were the staple of the district. The field was set for great advances, but the master-hand was lacking, and trade was even declining, owing to the competition of Delft or Dutch enamelled pottery, which was being imported in large quantities in 1759, the year in which Wedgwood commenced operations as a master potter.

So much, as the briefest of summaries, must serve as an indication of the outward circumstances in which Josiah Wedgwood commenced his great work. A few details as to his early life will serve as a slight guide to his reaction to these conditions. Born the thirteenth child of a master potter in modest circumstances in Burslem, he received such education as could be obtained in the local schools. This, however, only lasted until his tenth year, when his father died and he was put to work as a potter under his eldest brother Thomas. He appears to have had the instincts of an artist and a craftsman even at this early age, and became a proficient thrower. A violent interruption in the form of an attack of virulent smallpox laid him low after two years and this left after-effects, notably a weakness in the right knee, which ultimately led to the amputation of his leg. Returning to work, he soon found that he could not continue 'throwing,' and had to turn his mind to other branches of the work. The variety thus enforced, coupled with the suffering and meditation incident on his illness and its after-effects, must have assisted the godly discipline of his mother in developing a noble and imaginative character, whose great and indeed sole objective was to excel in his craft.

Wedgwood's mind having a strong experimental bent, and his brother having no desire to widen the scope of his manufactures, Josiah at the close of his apprenticeship threw in his lot with Harrison and Alders, owners of a small pottery, and later with a more progressive potter named Whieldon of Fenton Low. Even this period was not uninterrupted by illness, which only appears to have tempered the true steel of the young potter, and left his energies unabated. By now (1759) he had studied every branch of the manufacture of ordinary pottery and even its sale; being impatient of further restriction, he commenced business at the Ivy House, Burslem, having engaged a second cousin, Thomas Wedgwood. Thomas had previously been a potter at Worcester and afterwards became his cousin's partner in the manufacture of 'useful' ware, chiefly the improved cream ware. The business grew rapidly, potters were trained to the improved methods, and by 1763 the need for increased accommodation had become so pressing that Wedgwood took over the Brick House Works (Bell House), Burslem. His close application to every detail of manufacture, improvements resulting from constant experiment and subdivision of labour, resulted in what, in those days, was nothing less than mass production.

Having established his manufacturing unit on sound lines, Wedgwood now turned more and more of his attention to organising his connexion with

the outside world. An illness due to a further injury to his leg on the way to Liverpool led to a long stay in that town and a friendship with Thomas Bentley, out of which developed a partnership which relieved Wedgwood of a great part of the exploitation of his wares. Bentley gradually transformed his business from that of a general merchant and exporter to that of pottery merchant solely. Wedgwood and Bentley ultimately went into partnership in ornamental wares. The latter transferred to London and supervised the sales of Wedgwood ware in the Court circle, also managing an extensive decorating works in London. He secured artistic and other services and was a constant friend and adviser to his partner on almost every phase of the joint enterprise.

At this period Wedgwood entered into arrangements with Sadler and Green of Liverpool, with respect to the printing of outlines of on-glaze decoration according to the transfer method devised by Sadler. These outlines were afterwards filled in by hand. The method was later extended to include the whole decoration. Sadler and Green also possessed enamel kilns of their own for fixing such decoration, and did a thriving trade by buying ware, particularly from the Liverpool potteries, decorating it and reselling.

By the time these developments had taken place, Wedgwood's improved cream ware had become an important article of commerce, restored the export trade of Great Britain in pottery and been accorded Royal patronage, in honour of which it was henceforth known as Queen's ware. A further expansion of accommodation was necessary, resulting in the purchase of a new site, and the erection of what was then a model factory and village at Etruria, near Hanley. The Burslem potteries were still retained.

Wedgwood had also meanwhile been actively engaged in the improvement of local conditions, notably in taking a prominent part in the development of means of road and canal transport, and he reaped the benefit in the then ideal situation of his new works.

A new era of prosperity now opened up. The cream ware attained the height of its perfection. Exports to every part of Europe and to America continued to grow. Catherine II. of Russia commissioned the manufacture of a stupendous set of table-ware amounting to 952 pieces. A large number of these had to be specially modelled, and the plates and dishes were embellished, besides the normal rim decorations, with hundreds of paintings of English castles and mansions. Great use was made of the camera lucida in securing these views. It is doubtful whether this form of ornamentation can be considered to be in keeping with Wedgwood's excellent and restrained taste in decoration, but as a work of art, largely intended for show purposes, the set was certainly a wonderful achievement. A number of pieces corresponding to those of the set were also made for other purposes, but without the frog badge which was ordered as part of the original decoration.

Wedgwood's service to English pottery went much further than such improvements in serviceable ware as have been touched upon. He saw possibilities in ceramic products, of elevating the whole tone of artistic appreciation in the country and abroad. In his jasper body, a unique composition requiring great skill in manufacture, but yielding the finest results, he saw the possibility of reproducing works of art at a cost which would render their wide dissemination a practical proposition. Ceramics was to become to the arts as the invention of printing to the sciences. Space will not permit of any but the briefest reference to the lines this development took.

Excellent books exist to show the success he achieved. Wedgwood concentrated on every available source of artistic material, books of drawings from the antique, collections of cameos and gems, and the original works of a large number of artists, amongst whom Flaxman, Hackwood, Webber, and Tassie are pre-eminent.

The black basalt body had been improved to the point of making it an admirable medium for busts and vases. The jasper body, normally translucent and white, a delicate body of which the chief constituent was cawk or barium sulphate, was controlled as to translucency, the special difficulties encountered in its firing were overcome after lengthy experiments, and blue, green, yellow, lilac, and black bodies were prepared from it by suitable additions of colouring oxides; and their agreement with one another in firing shrinkage ensured.

The moulding of cameos, first with plaster moulds, was replaced by the use of the technically more perfect, but more troublesome moulds of fired clayware, and ultimately the finest results in coloured backgrounds were attained by the substitution of coloured washes or engobes for the solid coloured bodies. The use of the improved lathe was called in to add fluting, chequer, and other effects. The principal uses to which the new combination of materials and technique were put, lay in bas-relief ornament on ornamental ware of all descriptions, portrait cameos, medallions, vases, plaques, and panels for fireplaces and cabinet-work. The most famous, if not notorious, application lay in white jasper ornaments on the famous cobalt blue ground. Perhaps the most beautiful to the modern eye are the few existing examples of low relief classical ornament in white on the white ground. Undoubtedly, the most remarkable and difficult examples are the copies of the Portland or Barberini Vase.

A few words, even in such an incomplete account as this, must be devoted to Wedgwood's association with the scientific men of his day. Throughout his life he maintained as close a contact as possible with the progress of chemical and physical science. He was a regular correspondent with Priestley and Darwin (Wedgwood and Darwin were both grandparents of Charles Darwin), and well known to the fraternity of the Royal Society, to which he was elected for his clay shrinkage pyrometer. This was developed out of his experiments on controlling the heat in his ovens, and it remained for long unrivalled for the purpose.

Josiah Wedgwood made notable contributions

to our knowledge of glazes, colours, decorations, saggars, and in fact practically every department of pottery manufacture. It must be admitted that the times and conditions to which he was born conspired together to favour a rapid development of the pottery industry, and that other men of his day, Spode and Turner, for example, also made worthy contributions to that development. Nevertheless, it is clear that he was their acknowledged leader and a man of the greatest generosity and natural ability.

He died in January 1795 after a life dogged by ill-health, but inspired to the last with the creative enthusiasm of his craft.

The Importance of Cataclasms in Evolution.*

By Dr. G. P. BIDDER.

A CATACLASM is the result of an exceptional drought, flood, heat, cold, volcanic disturbance, or change in constituents of atmosphere or ocean, or other change in environment which over a large area is fatal to all species or individuals saving those which are exceptionally provided, quantitatively or qualitatively, so as to survive the ordeal. This definition is in strict agreement with Southey's use of the word in 1834 (Oxford Dict.). We may consider the essential phenomenon of a cataclasm as the reduction, by some violent happening, of a populous region of earth or sea to sterile emptiness, which is repopulated by the few survivors of the disaster.† Destruction may come upon all living beings from a volcano, or from a volcanic wave upon land and freshwater organisms, or from a pandemic disease upon only a single group of animals.

Darwin recognised the importance of the cataclasm, but he rarely emphasised it, probably because diluvial doctrines had so long held the field. It is now generally overlooked in theoretical discussions. The possibility of a given species-character or individual variation having survival value is commonly discussed from the point of view only of normal environment, without recognising that eschatological environment has equal or greater importance in the selection of races, and in regard to many characters must have been the only decisive factor.

If a small heritable quantitative or qualitative difference can lead to the survival of an individual in a catholic danger which destroys all individuals of the species not endowed with such a difference, then, though the danger recurs but once in 50,000 years, that difference must eventually be stereotyped as a character of the species. In the intervening 50,000 years of peace many successful variations may take place which do not include this saving difference, but they are pruned by the next similar cataclasm, the survivors of which will again all conform to type. Thus cataclasmic selection may enforce specific characters which are normally useless.

The position may be illustrated by considering at length the brief argument on the giraffe's neck in the sixth edition of the "Origin of Species", recalled to notice by Pycraft's interesting essay in *Science Progress* for January last. Darwin says: "The individuals which were the highest browsers and were able during dearths to reach even an inch or two above the others, will often have been preserved". The value of the passage is that it explains how, in the face of universal death, a very small quantitative advantage may save the individual. In normal times a giraffe with a neck two inches longer might gather 1 per cent more leaves than his brother and be perhaps ½ per cent better nourished; and the *advocatus diaboli* is in his rights when he claims that this would have no survival value. In the great dearth, when all on the ground is eaten and the trees are stripped up to the full height that the tallest giraffes can reach, all must die of starvation. Yet if half a dozen giraffes now come who can reach two inches higher, they will find two inches of untouched leaves on every tree, and they alone may survive, to transmit their slightly longer necks to their progeny after the cataclasm. ‡

On these premises, there is little positive advantage to the progeny in having a *long* neck; the advantage in a dearth is in having a *longer* neck than the rest of the population. At the next similar cataclasm the survivors would be those with necks two inches longer than the now increased usual maximum of neck, and the survivors of the second cataclasm would transmit necks two increments longer than those of the original population. In a dearth, two inches added to the mean or modal length of neck might add, perhaps, a few hours to the duration of dearth required to kill off the herd; but the deviational excess of the length of neck in a single individual may ensure his solitary survival through another month of dearth. If this deviational excess be heritable, we have it enforced on the post-cataclasmal population as an example of what we may term 'futile' evolution; defining

* Slightly modified from a paper read before the Linnean Society; abstract in *Proc. Linn. Soc.* for Feb. 6, 1930.

† The word 'cataclysm' has a valuable use in its original technical significance of a widespread submergence of land. This was a legitimate application of the English form of the Greek word in Matthew xxiv. 38, the Vulgate Latin 'diluvium' having been reserved for the supposed post-Tertiary universal deluge. The modern protean use of 'cataclysm' threatens to render the word unserviceable.

‡ Such transmission will obviously take place to all descendants if the two-inch longer neck be a Mendelian recessive mutation, and to 8/9 of the descendants if it be a Mendelian dominant, and the survivors show a typical sample of $2DD+4DR$. Most biologists would agree that there is no transmission if the extra height is merely 'metampic'—due to especially favourable accidents of nutrition and the like. But on Galton's "famous law of Heredity, which declared that to the total heritage of the offspring the parents on the average contribute 1/2, the grandparents 1/4", etc., if we agree with Bateson (1909, "Mendel's Principles of Heredity", p. 6) that "there was admittedly a statistical accord between Galton's theory and some facts of heredity" and consider that the facts as to stature in giraffes probably come into this category,—then, if all the pre-cataclasmal ancestry be assumed normal, all the post-cataclasmal progeny would have a mean which deviates from the pre-cataclasmal mean by half the deviation of the survivors through the ordeal.

'utile' evolution as that which enables the species to populate an environment where it could not otherwise have lived. (Futility in evolution, not cataclasmal, is shown by the useless height of the 'canopy' in forests the trees of which have long been forest-trees, competing each against his neighbour.[1] In human affairs, competition between nations has produced alike the evolution of manufacturing machinery, which is utile, and the evolution of battleships, which is futile.)

Of the survivors who had been exposed to the Black Death in London many would have been selected for a physiological difference which enabled them to resist a single disease. Since many centuries of normal environment had not selected this difference, those who possessed it were probably inferior men in normal environment. The death in a war of a disproportionate number of the best of the nation is too widely and bitterly believed to be discussed.

The Black Death killed up to half the population, but we are considering especially cataclasms after which not 1 in 1000 is left alive. The problem presented itself in connexion with littoral sponges. I have maintained the thesis [2] that the evolution of the canal-system in sponges can be shown to result in the continuously improved separation of the expelled water, which is foul and deprived of food, from the supply of fresh water taken in: the accepted sequence of evolution of the canal-system demonstrably resulting in a more forcible jet from the vent, carrying the used water farther away from the sponge.

On the rocks of Plymouth Harbour grow in profusion the sponges *Halichondria*, *Grantia*, and *Sycon*. Sycon's well-known bottle-brush scheme of canals is most easily shown to result in the jet (represented by the handle of the bottle-brush) having enormously more power than its tributary currents, which pour into it radially along the bristles. *Halichondria* is the sponge in which Grant discovered sponge-currents: he vividly described the extraordinary power of the ejection of water from the volcano-like vents of the sponge. With *Grantia* I have been able to demonstrate to friends a jet some inches long, several times its own length, even from a rather unhappy sponge.

These three sponges live between tide-marks in the surf and the swirl, and the power of their jets is in that environment of absolutely no value to them. It is known that they have lived on similar rocks in those parts for a hundred years with a generation every year, and it is reasonably certain that they have so lived for 10,000 years, and probably very much longer. It seems certain, on the other hand, that their beautifully perfect canal-system—so admirable adapted to bring them food and oxygen in still water—*must* be essential to them.

These apparent contradictions are reconciled if we consider that every now and again—maybe once, maybe a few times in a century—the whole of that littoral between tide-marks may have every sponge on it killed, and perhaps nearly every living thing. The most obvious means of death would seem to be if heavy rain, of the rare intensity of an inch in an hour, were to fall on the rocks during the two hours of lowest spring-tide. This would certainly not happen nearly once a century, but extreme heat from the sun at low spring-tide is another possible lethal agency, and in that part of the coast low springs are at the time of day when heat is greatest. Confining ourselves still to natural causes, a landslip might conceivably poison the water, or mud might, for a tide, cover a long stretch of shore.

After such a denudation the sponge population would be replaced by the larvæ from sponges in sheltered submarine caves. Of the enormous number of larvæ from the surf-sponges, a few will fix on every surface within a long range. The young sponge in a still, shut-in, cave will not grow so large or so fast as her sister among the waves, but she can live and grow *because* of her perfect current system, and her larvæ can swim to the light, out of the cave, and repopulate the shore. So that for the next century or so, until the next disaster, the rocks will grow thick again with *Sycon*, *Grantia*, and *Halichondria*, which will be all descended from a few ill-nourished individuals that at the time of the cataclasm lived in retreats where a powerful canal-system was necessary to life. Consequently we find the shore populated by littoral sponges with an elaborate anatomy which is useless for littoral existence.

We see, therefore, that cataclasmal selection may enforce a character which (1) may be of no benefit in normal life; (2) may carry, associated with it, characters selected by environment before the cataclasm and transmitted because they were possessed by the only surviving organism; while (3) small quantitative differences may have survival value in a cataclasm. We may tentatively consider whether some unsolved zoological problems may not be explained by cataclasmal selection. Prof. Poulton [3] has suggested the interesting case of the whelks of the Red Crag, which are all sinistral. He has considered the probable explanation of this to be that there was a sudden refrigeration, which killed all but one whelk which happened to be sinistral, and that her progeny repopulated the Crag.* Great cold, great heat, and floods are the most widely recognised depopulating agencies in our past history: it may be permitted, interrogatively rather than assertively, to sketch some possible evolutionary results of the cataclasms such convulsions must have caused.

The mass-wanderings of lemmings, and in a less degree of mice, rats, and squirrels, appear explicable if we assume a mutational madness, the possessors of which were the only survivors of their kind from the glaciation of northern Europe, and their descendants the only rodents to spread themselves over northern Europe when free of ice again. The most inexplicable feature of the wanderings is the

* In 1882 all the Tile-fish off Nantucket were killed, 5000 to 7500 square miles of sea being covered with dead or dying fish, estimated to number 'one billion' (query, a thousand million?), fifty being counted in a square rod. This was attributed to the temporary lowering of temperature of the water.—Lucas, 1889, Report of National Museum, Washington, p. 612.

lemmings throwing themselves into the sea. Darwin's visualisation of the glacial epoch is helpful: "The inhabitants of the more temperate regions would at the same time travel southward, unless they were stopped by barriers, in which case they would perish".[4] Therefore the sane lemmings which would not throw themselves into the fjords and rivers perished in the increasing cold. Wiman* describes the state of a modern wandering horde as "a sort of madness"; may we not conclude that this madness was a mutation which had occurred among the lemmings at the Glacial Epoch? Unafraid, the lunatics plunged into the obstructing lake, and because it was mostly frozen got safely across, and continued their lunatic wanderings over insane distances which brought them into gentler climates where they were able to live and produce young lemmings with lunacy inherited from both parents. When the ice had passed these were selected again, because only the lunatics made the return journey; the others stayed south and died as the warmth increased. On this hypothesis, therefore, in the pre-glacial and again in the post-glacial generation every ancestor of the modern northern lemming was possessed with a wandering madness.

It is worth considering whether there may not have been crises in our own ancestry through which no man lived who was not possessed with the appropriate madness, and whether this form of cataclasmal selection may not explain some features in human psychology; particularly, perhaps, in the behaviour of a crowd. On the other hand, the great drought in the central steppes of Eurasia, which drove our ancestors to migrate with their herds over thousands of miles of wolf-hunted plains, may account for the difference in ability for sustained concerted action between the descendants of the stationary Mediterranean races and those of the migrants.†

The 'ordeal by fire' is one which must have left its mark in countries where forest-fires or prairie-fires are common, and where, therefore, during the ages, from time to time a succession of wind-changes will have extended the conflagration until the whole great forest was burned. J. Weigelt[5] says that one of the chief causes of mortality among larger animals escaping a fire is their being crushed to death by fellow-animals in the stampede. Is it possible that the extraordinary lateral spread of the horns of some buffaloes and oxen has enabled their ancestors in such a crisis to survive those of the herd whose horns curved upward or forward?

* Quoted by Weigelt.

† An observer of lemmings of considerable authority objected, at the meeting of the Linnean Society, that lemmings make no considerable migrations or traverses of water, but only scatter from infected burrows under the influence of a known bacterial disease which renders them irresistibly thirsty. Another, an authority on rodents, accepted this, and denied the mass-migration of rats or mice. These two authorities are in conflict with the observers quoted by Johannes Weigelt ("Rezente Wirbeltierleichen, 1927, Leipzig, Max Weg, p. 43): B. Högbom observed a dense horde of swimming lemmings 2 to 3 kilometres long near Tromsö, Wiman travelled through such a swimming horde for an hour, and A. Högbom observed a closely packed procession of some sort of field-mouse (all quoted from *Paläont. Zeitschr.*, 1913, Berlin; Bd. i, p. 147). Waterton was convinced that "rats move from place to place in large bodies" ("Natural History Essays" [1870], London, Frederick Warne, p. 241), but he only quotes one witness. Lyddekker (*Enc. Brit.*, 1910–11, "Lemming") bases on Collett a circumstantial description of mass-migrations of the lemmings lasting one to three years, and writes that they are "impelled by the restless or migratory instinct possessed in "a less developed degree by so many of their congeners".

I am told that in Australia the first sign of a fire in the forest is the escape of the winged things—birds and insects. This gives another reason for delicate olfactory organs in insects, equally cogent with sex or food.

In Australia every tree and bush is burned, and nothing remains but hot ashes—through which the seedling eucalypti rise to refill the long swath in the forest. But in Siam and India the old teak-trees stand, and in Honduras the mahogany trees, and Pinchot[6] says that in the United States, "Trees whose thick bark or abundant seeding gives them peculiar powers of resistance, frequently owe their exclusive possession of vast areas purely to the action of fire". In such resistant trees bees-nests might be unburned even if all the bees were killed by the smoke. Is it conceivable that the use of wax for the cells by social bees, instead of salival cement, has had the survival advantage of protecting the pupæ from the poisonous vapours of the forest-fire which suffocate the adults of the hive?

Is it possible that the high development of the spleen, which can now save the life of a man after moderate poisoning by carbon monoxide, may have been forced upon mammals by forest and prairie fires? It must be remembered that for selective efficiency these disasters need not be frequent if they are terribly mortal.

Dr. G. S. Carter has recently explained[7] his interesting theory that fishes took to breathing air because of the lack of oxygen in tropical swamp-water. I am not aware whether the descendants of any freshwater fish in the Carboniferous epoch were represented as freshwater fish in the Tertiary rocks. *A priori* it would seem possible that with the enormous extent of stagnant tropical swamps at the time of the coal measures, all their aquatic inhabitants which were not air-breathing were suffocated, and so the sole descendants of carboniferous fresh waters may be the land animals.

I will touch very lightly on the question that interests me very much—the probability, when we find an enormously numerous and powerful group, such as the insects or the birds, predominantly of one design, that their ancestors went through some deadly ordeal in a fairly advanced stage of their history, from which only one (or very few) species survived, so that the orders and families of the group are variations on a highly specialised ancestor the general scheme of whose structure is preserved. Elsewhere I have suggested[8] that in the case of the insects the ordeal was the violent flooding of the land (cataclysm) in Torridonian times, from which one or possibly two or three species of insects were the only land animals to survive. The Silurian fossil evidence is now considered by entomologists to be negative, but on the other hand they find it difficult to explain the insects of the Carboniferous and Upper Devonian without assuming a long history behind them.[9]

For the birds—is it possible that their ordeal was a sudden development of rapid movement in flesh-eating mammals, which massacred every bird

(excluding ostriches, penguins, and so on) except the one species which had learned to perch on a fine twig? I am too ignorant to judge or discuss this question, and am conscious that we have touched above on many questions as to which I am culpably ignorant, and seek and expect correction. My object, in thus inviting personal humiliation, has been to ask each biologist whether, in the groups of which he has knowledge, the recognition of cataclasmal selection may not explain otherwise inexplicable characteristics, as it appears to me to do in the littoral sponges.

[1] Described in *Proc. Linn. Soc.* for Mar. 6, 1930: "In the Canopy of the Forest", by Major R. W. G. Hingston.
[2] *Quart. Jour. Micr. Sci.*, **67**, p. 293; 1923.
[3] *Proc. Linn. Soc.* for Feb. 6, 1930.
[4] "Origin of Species" (First Edition), p. 366.
[5] Loc. cit. p. 40.
[6] "Forests and Forestry", *Enc. Brit.*, 1910–11, p. 658.
[7] *Proc. Linn. Soc.* for April 18, 1929, p. 53.
[8] *Brit. Assoc. Rep.* (Leeds), 1927, p. 60.
[9] Tillyard: NATURE, June 12, 1926; *Trans. Ent. Soc. Lond.*, 76, p. 70; 1928.

Obituary.

DR. JAMES WATERSTON.

THE death of James Waterston, which occurred on April 28, some weeks after a serious operation, is a severe blow to applied no less than to systematic entomology. For many years past Waterston's entomological interests, though largely concerned with the British Mallophaga (bird-lice) and with the Siphonaptera (fleas), had centred chiefly in the, usually minute, Hymenoptera known comprehensively as Chalcidoidea, many of which are of extreme importance as being in the larval state parasitic in caterpillars destructive to crops, in the pests of stored grain, and in other harmful insects such as tsetse-flies.

Born at Paisley on Feb. 7, 1879, Waterston was educated at George Watson's College and the University of Edinburgh, where he graduated, with honours, in divinity, philosophy and science, and afterwards proceeded to his doctorate in the latter subject. After spending some years in the ministry of the Free Church of Scotland, during which he published many papers on ectoparasites, Waterston resigned his living in the Shetlands, and, in April 1914, joined the staff of the Imperial Bureau of Entomology; his interest in and work upon the Chalcidoidea date from this period. In May 1917, after receiving a temporary commission in the R.A.M.C., Waterston was appointed entomologist to the Malaria Commission, Salonica, being afterwards mentioned in dispatches and demobilised after the Armistice with the rank of captain. On May 20, 1920, he left the service of the Imperial Bureau of Entomology and entered that of the Trustees of the British Museum, in which at the time of his death he occupied the position of assistant keeper (first class) in the Department of Entomology.

A good all-round zoologist, capable botanist, and strenuous and enthusiastic worker at the groups of insects which more especially appealed to him, Waterston was also a prolific writer, and, commencing in the year 1903, published no fewer than one hundred and sixty-four entomological papers. While the majority of these more particularly concern the systematist, the list includes pamphlets on fleas and lice (in the British Museum "Economic" series), and a valuable paper on the bionomics of sand-flies (*Phlebotomus*), issued in 1922 as one of the results of his field experience in Macedonia. Among the projects abruptly terminated by Waterston's untimely death is a monograph of the British Mallophaga, for which a portion of the text and many of the illustrations had already been prepared.

Waterston's wide knowledge was ever at the service of those who sought his aid, and few of those who did so and found him at work at his table in South Kensington can fail to have been struck with his marvellous gifts as a dissector of tiny insects. To see him disarticulate, and display on a microscope slide, the mouth-parts or genitalia of a Chalcid, which itself measured but a millimetre or two in length, was a lesson in technique not easily forgotten.

E. E. AUSTEN.

MR. HUGH S. R. ELLIOT.

BY the lamentable aeroplane accident which occurred at Hampton in Middlesex on May 6, an able and popular writer on scientific and philosophical subjects has been removed from our midst at the early age of forty-nine years. Mr. Hugh Samuel Roger Elliot was born on April 3, 1881. His father was the Hon. H. F. H. Elliot, son of the third Earl of Minto; and he himself was a cousin of the present earl. He was educated at Eton and at Trinity College, Cambridge. But his career at Cambridge was cut short through the outbreak of the South African War in 1899, when he obtained a commission in the Coldstream Guards.

On leaving the army in 1902, Mr. Elliot devoted himself largely to scientific and philosophical studies. His first considerable literary undertaking was to edit the two volumes of "The Letters of John Stuart Mill", which appeared in 1910. This piece of work he accomplished with conspicuous care and thoroughness; and his estimate of Mill's character and achievements in the introduction is remarkably just and discerning. Unfortunately, one can scarcely speak in like terms of the book he published two years later, entitled "Modern Science and the Illusions of Professor Bergson". While, no doubt, he did succeed in exhibiting some of the weaknesses of Bergson's philosophy, he had too little patience with Bergson's mode of thought to appreciate its real significance, and his criticism of it was for the most part superficial and ineffective. He was far more at home in the volume he wrote on "Herbert Spencer", which was one of a series edited by Basil Williams and published in 1917. In his younger days he had been a fervent admirer of Spencer; and although, after an interval of fifteen years, he had come to see that much of the 'synthetic

philosophy' was ill-founded and false, the book is an interesting and sympathetic study of Spencer's work and personality. A serious blemish in Spencer's evolution theory seemed to Mr. Elliot to be the assumption of the transmission by heredity of acquired characters, an assumption which he took to be without justification. He had already argued to the same effect in the introduction he wrote to his translation of Lamarck's "Philosophie Zoologique". This translation, which was done with great skill and accuracy, appeared in 1914.

Mr. Elliot had a rooted contempt for what he called 'metaphysics', which he stigmatised as "a maze of sesquipedalian verbiage, beyond the reach of science to defend or to refute". Probably he got his conception of 'metaphysics' from the treatment in "First Principles" of 'the Unknowable', which he regarded as altogether extraneous and unnecessary to Spencer's philosophy as a whole. He himself defended a thorough-going doctrine of materialism, according to which 'physical law' is universally dominant, and mind or consciousness is "only an inert accompaniment of material cerebral changes". In his later volume, "Modern Science and Materialism", which was published in 1919, he was, however, compelled to modify to some extent his earlier view.

Mr. Elliot was a forcible and trenchant writer; his books and essays were always readable, even when they failed to carry conviction. He was happier in expounding scientific theories than in criticising philosophical ones; and his articles on social and political topics were characterised by keen insight and sagacity. His materialistic doctrine is already a spent force; but his survey of Spencer's system and his account of Lamarck's contributions to biology are not likely soon to be forgotten. G. DAWES HICKS.

DR. P. A. WAGNER.

THE death of Percy Albert Wagner on Nov. 11, 1929, at the early age of forty-four years, removed from a larger sphere than that of South Africa one of the most prominent workers on the economic side of geology. Conjointly, the South African School of Mines, Freiberg and Heidelberg, contributed to the determining of his career. Much was accomplished in that relatively short life, principally among the platinum and diamond deposits of the Transvaal, and to a rather less extent in the geology and mineral resources of South-West Africa, for Dr. Wagner seldom strayed in his investigations beyond the southern section of the continent. His Memoirs on the "Fides-Stavoren Tinfields" (1921), on the "Iron Deposits of the Union of South Africa" (1928), and that exceptionally interesting work on "The Pretoria Salt-pan, a Soda Caldera" (1922), are typical examples of the thorough—and also the clear and systematic—manner in which the subject on hand was treated.

The salt-pan formed one of the 'Problems' dealt with in Wagner's presidential address to the Geological Society of South Africa in 1917. An earlier book on "The Diamond Fields of South Africa", written in 1915 (preceded in 1909 by a volume on the same subject published in Berlin), is still a standard work of reference. "The Platinum Deposits and Mines of South Africa", in which the structure and petrography of the Bushveld Complex receive all but exhaustive treatment, is an outstanding example of the minute care with which he handled his subject, dealing with it, so far as was possible, from every point of view. In describing these sulphide ores, he was in his element.

Appointed Geologist for the Mineral Survey in 1918, Wagner left Government service in 1927 to undertake consulting work, chiefly concerned with platinum and diamonds, finding it necessary to crowd much writing into time which most men would have considered fully occupied with strictly professional matters. In his last memoir for the Geological Survey, that on the "Iron Deposits", he laments that he had only two and a half months for the microscopic work and systematising and summarising the observations of the preceding ten years. "The Platinum Deposits" was written hurriedly, but one looks in vain in either for those "obvious shortcomings" he saw himself in the earlier work. The memoir on "The Geology and Mineral Industry of South-West Africa" (1916) is a most useful compendium of original observations and the publications of other geologists, mostly German, but perhaps the broad outlines of stratigraphical geology were not altogether Wagner's *métier*, though one feels that had his bent led him in this direction, he would have accomplished much.

As his field work was essentially South African, so Dr. Wagner's publications are principally to be found in South African journals. No paper of his appears under the ægis of the Geological Society of London or in the *Transactions* of the Institution of Mining and Metallurgy. This is of small moment; his reputation was world-wide, and even those of his profession who had never met him felt a keen sense of loss at his untimely death. J. P.

WE regret to announce the following deaths:

Prof. John N. Cobb, dean of the College of Fisheries at the University of Washington, Seattle, a past president of the Pacific Fisheries Society, on Jan. 13, aged sixty-two years.

Mr. G. C. Dudgeon, C.B.E., formerly consulting agriculturist, Ministry of Agriculture, Egypt, well known for his interest in tropical agriculture and entomology, on May 4, aged sixty-two years.

Prof. Stephen A. Forbes, since 1917 chief of the Illinois State Natural History Survey, member of the U.S. National Academy of Sciences and past president of the American Entomological Society and of the Association of Economic Entomologists, on Mar. 13, aged eighty-five years.

Dr. Christine Ladd-Franklin, lecturer in psychology and logic at Columbia University, and originator of the theory of colour vision known by her name, on Mar. 5, aged eighty-two years.

Prof. Max Matthes, director of the University Medical Clinic, Königsberg, one of the secretaries of the German Society for Natural Science and Medicine for the forthcoming meeting in Königsberg, on Mar. 26, aged sixty-five years.

News and Views.

THE organisation of the Wedgwood festival, held during the past week in Stoke-on-Trent, has been remarkably efficient. Judging by the tremendous enthusiasm shown and the large attendances in the earlier items of the seven-day programme, the Wedgwood bicentenary will leave a lasting impression on the minds of many thousands. Commencing with suitable religious observances on Sunday, followed by a day of which the outstanding feature was the tremendous reception accorded to Princess Mary, succeeding days were allotted to transport, ceramics, industry, foreign trade, and Staffordshire. Throughout the weekdays the remarkable historical pageant has been staged every afternoon in the most central park of the city. The pageant was a great work of art embodying the musical, historical, and histrionic abilities of the district. In a prologue and eight episodes, the history of the district was illustrated from the days when the early Britons stood in fear of the Roman legions in their midst up to the present day. Perhaps the most interesting episode of all concerned the life of the great potter in whose honour the celebrations took place. Incidents in the life of Josiah Wedgwood from the time when, as a youth, he worked at the bench as an apprentice, up to the latter days, when he had become a great industrial leader and an honoured man of science, were shown with a faithful representation of conditions and costumes which made the history live again.

THE modern claims of the pottery industry to world-wide appreciation were splendidly upheld by an exhibition in Stoke-on-Trent of the products of some seventy firms, amongst whom are some of the most famous makers of china, earthenware, tiles, sanitary and electrical wares. It is confidently asserted by independent witnesses that no exhibition of modern pottery of such variety and merit has been staged anywhere since the War. The display of pottery of historical interest, exhibited in the Hanley Museum and including some of the choicest examples of jasper ware from H.M. the Queen's collection, was alone worthy of a special visit. Included in this display we particularly noted one of the copies of the Portland Vase, an encaustic painted vase thrown by Wedgwood's own hand on the day in 1769 when the Etruria Works was formally opened, and a number of portraits in oils, of which one of Josiah Wedgwood by Reynolds is probably the most important. The Ceramic Society, in issuing Part I. of its commemorative volume, has produced a work of exceptionally varied interest. Contributions from technical specialists the world over deal with a wide variety of important questions, whilst the prize essays on the contributions of Josiah Wedgwood to the technical side of the pottery industry embody new material of the greatest value.

THE opening on May 15 of the Electrical Research Laboratory at the Stourport works of Steatite and Porcelain Products, Limited, is a welcome sign that manufacturers now thoroughly recognise the importance of scientific research. We agree with the remark made by Sir Philip Nash at the ceremony that in the future there will probably be a great network of international lines for power transmission. This would bring power to our industrial centres at a price much cheaper than they can generate it for themselves. The power must be transmitted at the highest possible voltage, and so the manufacture of porcelain insulators is necessary for our progress. The new research laboratory at Stourport is equipped with apparatus for testing both the mechanical and electrical properties of the insulators. There is a high-voltage room, a mechanical laboratory, a fog room, and an open-air testing field. The high-voltage room covers 4300 sq. ft. and is 45 feet high. It is equipped with a 500,000-volt testing alternator and two 450,000-volt testing transformers. A pressure of a million volts can be obtained, and by connecting in cascade the pressure can be increased 20 per cent. In addition, an impulse plant in which two high-voltage condensers are charged by a unidirectional current enables the effect of a direct lightning stroke to be imitated. It is stated that in this way pressures of 1,800,000 volts have been obtained. The unidirectional current for charging the condensers is obtained from a mechanical rectifier, which allows a voltage double that of the peak voltage of the transformer supplying the current for rectification to be obtained. The tests are applied to the insulators under normal conditions and under artificial rain. In addition, in the special room, investigations can be made under conditions of heavy fog, mist, salt spray, and artificial fouling by solid matter. The mist is obtained by suspending the insulators in a refrigerator and then removing them to the higher temperature of the fog room.

PROF. NIELS BOHR delivered the fourteenth Faraday lecture before the Chemical Society on May 8, the title of his discourse being "Chemistry and the Quantum Theory". Prof. Bohr said that we owe to Faraday a large part of the common basis on which chemistry and physics are to-day being built; in order to appreciate the situation in which we now find ourselves, we have to take account of the attitude of mind characteristic of physical and chemical research. Two fundamental discoveries were those of the quantum of electricity and the quantum of action, characteristic of two different aspects of the atomic theory. The discovery of the structure of the atom gives us a picture of the units of electricity, but the behaviour of these particles cannot be described by the ordinary ideas of mechanics and electricity. The discovery of the quantum of action resulted from a study of statistical problems; as soon as we attempt to get an idea of what this quantum of action is, apart from the statistical view, we find it an impossible task. Having referred to quanta of light, and to the modern view of the significance of line spectra, Prof. Bohr said that the problem of utilising the discovery of the structural unit of the atom in explaining its properties is

difficult, for any reference to the mass of a particle requires reference to Newton's classical mechanics. Interpretation of the properties of elements becomes possible if variations in the direction in space of the magnetic moment of the electron are postulated. Progress has depended on the application of the correspondence principle correlating quantum mechanics with classical mechanics, and has been facilitated by the introduction of the concept of wave-mechanics.

CONTINUING, Prof. Bohr said that wave-mechanics, conceived by De Broglie, has provided us with correlation between the motion of a particle and wave propagation. The electron is not the wave, nor can we discover its paths of motion, but we are able to determine whether an electron is or is not there. Whenever we experiment on an atom, therefore, we always find it in one of its stationary states; this view of the existence of atoms in 'stationary states' has been confirmed by every experiment yet designed to test it. The existence of a quantum of action leads to the position that we cannot obtain any knowledge concerning natural phenomena without influencing them by our observation. According to our ordinary ideas, the electron has position and momentum, but when we attempt to prove that it is at a certain point, we find that we cannot do so without affecting its momentum. Hence we can never get simultaneous knowledge of position and momentum. Prof. Bohr declared that this disability represents something quite fundamental; it implies that space and momentum are in some degree mutually exclusive. Similar limitations are concerned with time and energy; we cannot at the same time use the concepts of time and of conservation of energy. In considering the stationary states of the atom, we are not concerned with time, and hence the idea has a large field of applicability. Referring to the work of Dirac, Prof. Bohr remarked that it is never possible to measure the electric moment of a single electron. The word 'electron' is losing its simple meaning. A large part of the progress of physical science has been concerned with motion and mechanics; chemists, who have been largely concerned with properties, must follow so far as possible the concepts of motion. At the conclusion of the lecture the president, Prof. J. F. Thorpe, presented to Prof. Bohr the Faraday Medal, the highest honour in the bestowal of the Chemical Society.

MR. H. A. STUYT'S paper on "The Bavenda", delivered at the Royal Anthropological Institute on May 13, and Major Trevor's paper in the preceding week on certain survivals of pre-European culture among the natives of Rhodesia, were both of noteworthy importance in their bearing upon one side of the Zimbabwe controversy. It has always been something of a stumbling-block, to some at least, in the way of the complete acceptance of the theory of the native origin of the Zimbabwe ruins, that while the culture as a whole is distinctly African—a point brought out very emphatically by the present exhibition at the British Museum—it does embody elements which appear, so far as known, something of a departure in Bantu culture, and at best scarcely cognate to the culture of the natives of to-day. On this point the observations of both Major Trevor and Mr. Stuyt appear to throw some light. For in culture and social and religious organisation the Bavenda show marked differences from the other native tribes of Rhodesia. Major Trevor, for example, noted the existence among the Bavenda of clay phallic altars in use in initiation ceremonies, while Mr. Stuyt directed attention to carved wooden dishes or bowls used for purposes of divination ceremonies, which present a close resemblance to the shallow clay trays now exhibited from Zimbabwe. It is noteworthy that the Bavenda make use of dry-stone wallings very similar in appearance to those at Zimbabwe. One kraal also exhibited the remarkable and rare occurrence of a monolith erected upon it, again recalling a feature of Zimbabwe. These, with many other similarities, are sufficient to point to the possibility of the Bavenda having occupied the Zimbabwe country. Although copper working is not yet definitely associated with Zimbabwe, it is possible, for until forty or fifty years ago the Bavenda were copper workers.

IN his Friday evening discourse delivered at the Royal Institution on May 16, Dr. C. M. Yonge described the Great Barrier Reef of Australia and discussed some of the results obtained by the expedition under his leadership which has recently investigated its structure and biological associations. The reefs are built up on a shallow platform which fringes the north-east coast of Australia and is very wide in the south but narrows in the centre, to broaden out again in the region of the Torres Strait. The reefs are most abundant near the outer side of this platform, and so enclose a sheltered channel which forms the main steamer track from the eastern ports of Australia to the Far East. This channel is dotted everywhere with islands, of which many are high, rocky, and of great beauty and were probably originally part of the land mass of Australia, while in the northern half of the Barrier there are great numbers of small coral islands. These low woody islands, on one of which the Great Barrier Reef Expedition lived for twelve and a half months, are all situated on small reefs moulded into a crescent shape by the south-easterly trade wind. They each possess on the lee side a small sand 'cay' covered with trees and bushes, and on the exposed south-eastern side, in the shelter of great banks of shingle, mangrove swamps. The reefs of the Barrier can be divided into two series, outer and inner. The former face the full force of the Pacific and are swept bare on the upper surface, while the inner reefs are a little higher and so exposed more by the tides and have occasionally small sand cays upon them. There is a great abundance of coral on their outer slopes, which descend quickly into deep water, while on the sheltered lee of the reefs great pinnacles of living coral render navigation difficult. This great series of reefs possesses many animals of economic value, while its powers as a natural breakwater have earned for the enclosed channel the title of Australia's Grand Canal; but it is a canal full of dangers, as frequent shipwrecks testify.

IN a recent address to the Students' Section of the Institution of Electrical Engineers, Sir Thomas Purves, the engineer to the Post Office, gave an interesting account of ship-shore telephony, the latest development of electrical communication engineering. The service at present covers the Atlantic Ocean. The main receiving station is at Baldock, about 30 miles north of London. The site of the station is in the centre of a large flat plain, carefully chosen so that no roads are nearer than a quarter of a mile to the aerials. This is to prevent interference from the short waves which are radiated from the ignition systems of motor cars. The working wave-length of the receiver can be varied continuously over the range between ten and a hundred metres. The transmitting station is at Rugby and can be worked at several frequencies. For short-wave telephony it is necessary to maintain the transmitted frequency within limits of the order of one part in ten thousand. Piezo-electric quartz oscillators, therefore, are provided. They are enclosed in an oven the temperature of which is automatically regulated within very narrow limits. The transmitter supplies a high frequency carrier wave to the aerial with an output power of about five kilowatts. The procedure of making a call is as simple as that of any long distance trunk call. The charge for the service is £4 10*s*. for three minutes plus £1 10*s*. for each additional minute. The connexion of Rugby to the London trunk exchange is by 85 miles of underground cable, and Baldock is connected by more than 30 miles of cable to the same exchange. On a recent outward voyage of the S.S. *Majestic*, the useful period of 10 A.M. to 6 P.M. ship's time was adequately covered. The output of the ship's transmitter was about two kilowatts. The principal wave-lengths used are 16, 24, and 36 metres, but in order to improve the communication at very short ranges, experiments on longer wave-lengths are being made.

MR. H. C. LAMB, engineer to the Manchester Corporation Electricity Department, gives an interesting account of the development of the Manchester system of supply in *World Power* for March and April. The public supply began in 1893 to an area of about one square mile. It has now grown to fifty-two square miles. The initial supply was at 200 volts on the three-wire system, as early electric lamps were only made for pressures of 100 volts. In 1902 high pressure supply was started at 6600 volts, three-phase, with conversion to direct current supply at substations. In 1923 the Barton Power Station with its connected system of 33,000 volt underground mains was brought into use. These transmission lines go to seven points where the current is transformed down to 6600 volts and then supplied to the distributing substations. The coming of the 'grid' has affected the development of the Manchester system. The grid in the north-west of England and in North Wales can be divided roughly into three main rings and the Barton Station forms a pivotal point for them. Just as the 6600 volt network became a secondary when the 33,000 volt supply was introduced, so now the 33,000 volt supply has become a secondary system owing to the introduction of the 132,000 volt grid. It is difficult to say whether this is the final stage in the development or not. It would be unsafe to prophesy. The enormous power now being distributed and the absolute necessity of continuity of supply has led to the introduction of a very elaborate and complicated system of safety devices and fault-clearing apparatus. Mr. Lamb recalls that, in the early days, all the mains were connected up directly with the generators without fuses or circuit-breakers. When faults occurred —and there were many—the engines groaned, the brushes on the commutators sparked violently, and the staff held their breaths as the fault burned itself clear.

MANY suggestions are being made for supplying electricity on an economical basis to remote rural districts. Several engineers are strongly in favour of increasing the permissible variation of the supply at the terminals of the consumer. At present, if the supply company varies the pressure of supply by less than four per cent up or down, no legal action can be taken. To give it permission to increase this variation to five or six per cent would in many cases diminish considerably the costs of distribution to the company without affecting in any way the great bulk of its consumers. Only a few consumers on the outskirts of the network, and those near the station, would be affected, and probably the small alteration in the pressure would pass unnoticed. The legal enactment necessary to provide for this change would doubtless insist that the saving effected would be reflected in the charge to the consumer. On the other hand, the lamps of the consumers living near the source of supply would have a shorter life, although their efficiency would be increased. The lamps of those living far from the station would have a long life and low efficiency. When it is remembered that a variation of one per cent in the pressure means a variation of three or more per cent in the light given out, it will be seen that a variation of six per cent would scarcely be fair to those whose pressures are effected, although they might not notice it, as sudden changes rarely occur. It would be very costly to treat every consumer equitably. We see no objection to allowing a latitude of six per cent in special cases where the present rule makes a proposed scheme uneconomical and would-be consumers know what to expect.

A THOUGHTFUL paper by L. Berkeley and Major Raven-Hart on the effect of broadcasting on the development of music is printed in the *Nineteenth Century* for May. They point out that the musician and the music-lover of the future will be practically restricted to radio for their education, since for each one concert attended personally they will be provided with at least twenty by radio. For those living in the country, the proportion will be much higher. It may be objected that at the present time one concert attended is worth more than twenty heard by radio; but this is a passing phase. Radio technique is making substantial advances every year, and soon radio

listeners will be nearly on the level of the concert-goer. One effect of this will be that music which does not broadcast well will be more and more neglected. Bach broadcasts better than almost any other composer, and Wagner's music is very badly reproduced. Jazz, unfortunately, with its very often puerile harmony, comes through excellently. Luckily, however, there are great possibilities in connexion with broadcasting music. For example, when the composer desires a harp to give a solo, he does not need to reduce the rest of the orchestra practically to silence; all that is necessary is to move the harp nearer to the microphone. A tuning-fork can make itself heard against an orchestra in a concert hall. The pianissimo quality of a solo instrument can in this way be made to dominate any orchestration. A narrator can speak through a concert performance and almost overpowering emotional effects can be produced. This was excellently illustrated on Mar. 18 of this year when Hindemith-Weill's "Lindbergh's Flight" was transmitted from Berlin to London. The authors emphasise the need for immediate experimental work by musicians and broadcast engineers in close co-operation. This is already being done at the Berlin 'Wireless Academy', and the example should be followed in England. A month rarely passes in Germany without some important musical work being specially written for broadcast reproduction.

HISTORIC wireless apparatus, including early receivers and other apparatus used by Marchese Marconi and his collaborators, and an original Fleming two electrode valve, forms part of a window display at Marconi House, Strand. The Marconi aircraft transmitter, receiver, and direction finder which secured the rescue of Captain Courtney and his companions when their flying boat caught fire and was forced to descend in mid-Atlantic comprise another exhibit, illustrated by a series of photographs depicting the machine on the sea and the rescue. Other photographs show comparisons between modern and early wireless stations, including a photograph of the original 2LO; and a map is shown of present-day world-wide cable and wireless services. In contrast with the first valve are three modern transmitting valves, one of them of the water-cooled type, for broadcasting and high power wireless telegraph stations.

SCIENCE Service announces that at the recent meeting at Washington of the National Academy of Sciences the following medals were presented: Public Welfare Medal to the late Stephen T. Mather, organiser of the U.S. National Park Service and its director through the first years of its work; Daniel Giraud Elliot medal and honorarium, which is given for the most meritorious work in zoology or palæontology published each year, to Ernest Thompson Seton, whose book, "Lives of Game Animals", was selected as worthy of the prize for 1928; Agassiz Medal for oceanography to Dr. Johannes Schmidt, director of the physiological department of the Carlsberg Laboratory at Copenhagen, known for his work on the life history of the eel; Mary Clark Thompson Medal, for the most important services to geology and palæontology, to Prof. William Berryman Scott for distinguished work in palæontological research.

THE following have been elected members of the U.S. National Academy of Sciences: Prof. C. A. Adams (electrical engineering) Harvard University; Dr. J. W. Alexander (mathematics) Princeton University; Dr. Eugene T. Allen (geophysics) Carnegie Institution of Washington; Prof. Harry Bateman (mathematics) California Institute of Technology; Dr. Isaiah Bowman (geography) American Geographical Society, New York; Dr. G. P. Clinton (botany) Agricultural Experiment Station, New Haven, Conn.; Dr. William W. Coblentz (physics) U.S. Bureau of Standards; Dr. P. S. Epstein (mathematical physics) California Institute of Technology; Dr. Vernon L. Kellogg (biology) secretary of the National Research Council; Dr. F. G. Keyes (chemistry) Massachusetts Institute of Technology; Dr. K. S. Lashley (psychology) Institute of Juvenile Research, Chicago; Dr. Berthold Laufer (anthropology) Field Museum of Natural History; Dr. S. C. Lind (chemistry) University of Minnesota; Dr. Frank E. Ross (astronomy) Yerkes Observatory, and Dr. A. H. Sturtevant (biology) California Institute of Technology. Prof. R. A. Millikan, of the California Institute of Technology, has been re-elected foreign secretary of the Academy for a term of four years.

THE Second World Power Conference will be held in Berlin on June 16–25. This will be the second plenary meeting of the World Power Conference; sectional meetings have been held at Basle (1926), which dealt with the utilisation of water power and inland water-ways, the London Fuel Conference of 1928, at Barcelona (1929) on water-power utilisation, and at Tokyo (1929) on the development of power resources, the latter coinciding with the World Engineering Congress. The honorary patron of the 1930 Conference at Berlin is President von Hindenberg, the honorary president being Dr. Oskar von Miller, the founder of the Deutsches Museum at Munich and pioneer of the electrical supply industry, while Dr. C. Köttgen will be chairman of the Conference. The management of the Conference is in the hands of the organisation set up by the German National Committee for this purpose at the Ingenieurhaus, Berlin N.W.7. Of the 400 papers submitted, copies of which will be printed and sent out on request before the meeting, only the most important statements will be dealt with by the general reporter at the meeting itself. The discussions that then take place constitute the most valuable part of the Conference. In addition to the purely technical programme, a series of addresses on present and future power supply problems will be delivered, and on the conclusion of the Conference special facilities are being granted for visiting the most important power and industrial plants in Germany. The public lectures include one by Prof. A. S. Eddington, on "Subatomic Energy", and one by Prof. A. Einstein, on "The Physical Space and Ether Problem".

THE speech delivered by Sir Robert Hadfield, as chairman of Hadfields, Ltd., on the occasion of the

annual meeting of the company on Mar. 17 last, which has recently been issued, is in refreshing contrast to the usual type of address favoured by chairmen of industrial companies. It is to be wished that the directors of great industrial concerns were more frequently men of scientific attainments and experience, with an intimate knowledge of the processes and products of their undertakings. As might be expected of its author, the address ranges over a wide field, from the proposed scheme of an Empire Development Board, the importance of which the chairman has striven to bring home to the public as a practical alternative to the political and fiscal remedies now so widely advertised, to the recent developments in the metallurgy of steel. Sir Robert Hadfield shows some scepticism regarding modern tendencies in pure physics, but he fully recognises the value of scientific research, and records remarkable results obtained by the systematic investigation of the properties of metals. After discussing the changes which have been brought about in the practice of engineering by the introduction of manganese and silicon steels, he goes on to describe the uses of the heat-resisting steels which are now a special product of the firm. The fact that steels are now obtainable which have an extraordinarily high resistance to oxidation even when exposed for long periods to temperatures so high as 1200° C. is of the highest importance to the chemical as well as to the engineering industry.

A CONVERSAZIONE of the Institution of Electrical Engineers will be held, by permission of the Trustees, at the Natural History Museum, South Kensington, on Thursday, June 12, at 8.30-11 P.M.

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 7, when the Observatory will be open for inspection by guests of the Board of Visitors at 3.30 P.M.

DR. W. H. ECCLES will deliver his presidential address to the Institute of Physics on Tuesday, May 27, at 5.30 P.M., in the rooms of the Institution of Electrical Engineers, taking as his subject "The Influence of Physical Research on the Development of Wireless". The address is open to the public without ticket.

ON Wednesday, June 4, in the Physics Theatre of King's College, London, Prof. T. H. Laby, who is home on short leave from Melbourne, will read a paper before the Faraday Society on "Qualitative and Quantitative Atomic Analysis by X-rays". The subject matter of the paper is indicated in the letter by Prof. Laby and Mr. C. E. Eddy which appeared in NATURE of April 5, p. 524. Invitations to attend the meeting are being sent to physicists and metallurgists, and considerable interest is likely to be aroused by the technique used by Prof. Laby. At the same meeting a short paper by Mr. Calvert, who is working with Prof. G. Hevesy at Freiburg im Breisgau, will also be read.

THE Council of the Institution of Electrical Engineers has made the following awards of premiums for papers read during the session 1929–30, or accepted for publication: *Institution Premium* to Mr. H. H. Harrison; *Ayrton Premium* to Messrs. B. A. G. Churcher and A. J. King; *John Hopkinson Premium* to Mr. L. C. Grant; *Kelvin Premium* to Mr. T. G. N. Haldane; *Paris Premium* to Messrs. H. A. Humphrey, D. M. Buist, and J. W. Bansall; *Extra Premiums* to Messrs. S. W. Melsom, A. N. Arman, and W. Bibby, Messrs. E. H. Smythe and E. G. Weeks, Messrs. T. W. Ross and H. G. Bell, Mr. W. West, Mr. Bernard Leggett, Mr. J. C. Prescott, and Mr. H. W. Taylor. *Wireless Section Premiums: Duddell Premium* to Mr. J. E. P. Vigoureux. *Extra Premiums* to Capt. P. P. Eckersley and Mr. N. Ashbridge; Mr. G. Shearing, and Capt. J. W. S. Dorling.

THE first award of research fellowships in tuberculosis provided from a fund established by a recent benefaction in memory of Dorothy Temple Cross will be made by the Medical Research Council in July, for the academic year beginning on Oct. 1. Applications should be lodged with the Council not later than June 30. The object of the fellowships, as defined in the trust deed, is to give special opportunities for study and research to persons "intending to devote themselves to the advancement by teaching or research of curative or preventive treatment of tuberculosis in all or any of its forms". Candidates must be British subjects, and must possess suitable medical, veterinary, or scientific qualifications. The fellowships will preferably be awarded to candidates who wish to conduct their studies or inquiries outside Great Britain. Each fellowship will be of the value of not less than £300 per annum, with travelling expenses in addition, and will be awarded for one year. It is also hoped to award one senior fellowship of considerably greater value to a well-qualified candidate wishing to undertake intensive investigation into some special problem of tuberculosis. Particulars are obtainable from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S.W.1.

THE Report of the Director-General of Public Health, New South Wales, for the year 1928, which has recently been issued, records the vital statistics for 1928 and gives full information on the public health administration of the State. The birth-rate was 22·59, and the death-rate 9·55, per 1000 of population, being 4·5 per cent and 1·0 per cent respectively below the averages of the previous five years. Deaths from pulmonary tuberculosis continue to diminish, while the deaths from cancer and heart disease are increasing year by year. We miss the research articles which have been included in former reports, only one investigation (on atmospheric conditions in textile mills) being reported.

MESSRS. W. Heffer and Sons, Ltd., Petty Cury, Cambridge, have just issued Catalogue No. 348 of second-hand works, over 2000 in number, dealing with zoology and biology, anthropology and ethnology, agriculture, botany and gardening, chemistry and chemical technology, geology and palæontology, mathematics and physics, physiology, anatomy and medicine, etc. The catalogue should be of service to librarians and others anxious to fill up gaps in their libraries.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—Probationary assistant constructors in the Royal Corps of Naval Constructors—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (May 26). A full-time engineering workshop instructor at the School of Engineering and Navigation, Poplar—The Education Officer (T.1), County Hall, S.E.1 (May 26). A lecturer in biology, specially interested in sea-shore life, at the Brighton Municipal Training College for Women—The Secretary, 54 Old Steine, Brighton (May 30). An advisory and research entomologist at the South-Eastern Agricultural College—The Secretary, South-Eastern Agricultural College, Wye, Kent (May 31). Full-time lecturers in mathematics and biology at the Chelsea Polytechnic—The Principal, Chelsea Polytechnic, Manresa Road, S.W.3 (May 31). A town-planning assistant on the County Surveyor's staff of the Lancashire County Council—The Clerk of the County Council, County Offices, Preston (May 31). Inspectors of mine beacons in the Mines Department of Southern Rhodesia, and assistant road engineers in the Roads Department of Southern Rhodesia—The High Commissioner for Southern Rhodesia, Crown House, Aldwych, W.C.2 (May 31). A full-time teacher of electrical engineering at the Oldham Municipal Technical College—The Secretary for Education, Education Offices, Oldham (May 31). Two assistants at the Ditton Research Laboratory, East Malling, Kent, for making temperature observations and for running refrigerating machinery—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (May 31). A research assistant and demonstrator in geology in the University of Leeds—The Registrar, The University, Leeds (June 2). An assistant editor of the *Pharmaceutical Journal*—The Secretary, Pharmaceutical Society of Great Britain, 16 Bloomsbury Square, W.C.1 (June 2). A temporary full-time physics and chemistry lecturer at the National Society's Training College for Teachers of Domestic Subjects—The Principal, National Society's Training College, Berridge House, Fortune Green Road, N.W.6 (June 2). Chemists on the scientific staffs of research establishments of the Department of Scientific and Industrial Research—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (June 6). A lecturer and head of the zoology department of the University College of the South West of England, and an assistant lecturer in the same department — The Registrar, University College, Exeter. A head teacher of building construction at the Woolwich Polytechnic—The Principal, Woolwich Polytechnic, S.E.18.

ERRATUM.—In the letter in NATURE of May 17, p. 744, by Prof. G. Hevesy and A. Guenther entitled "Search for an Inactive Isotope of the Element 84 (Polonium)", seven lines from end should read: "1 gm. of each mineral examined cannot contain more than 10^{-11} gm. of the element in question."

Our Astronomical Column.

The Companion of Mira Ceti.—Prof. Aitken gives the following measures of this star in *Publ. Ast. Soc. Pacific* for February :

	P.A.	Dist.
1923·82	130·3°	0·90″
1924·69	131·6	0·84
1925·56	128·9	0·78
1929·98	134·9	0·85
1929·99	134·5	0·87

He notes that the companion was sometimes not seen when the conditions were good, and infers that it, like the primary, is variable. Its magnitude last December is given as 10.

Zi-Ka-Wei Observatory.—This observatory is four miles from Shanghai. It was founded in the sixteenth century by the Jesuit Fathers Ricci, Schall, and Verbiest ; after being long closed, it was reopened in 1873. A short illustrated history of the observatory has just been issued. Warnings of typhoons were formerly given by semaphore, but for the last fifteen years they have been given by wireless. The Fathers have received many testimonials of the value of these warnings, some specimens of which are reproduced. Time signals are now also issued by wireless. The observatory took part in the recent international determination of longitudes by wireless signals. There is a photographic equatorial with aperture 15½ in. ; this has been used *inter alia* for the formation of an atlas of the moon in 15 plates with Chinese text. The programme also includes sunspots, magnetism, and seismology, a star catalogue of 14,000 stars, and calculation of the perturbations by Jupiter of about 100 minor planets (the last by P. E. de la Villemarqué). The illustrations include an amusing Chinese caricature of the astronomers "looking for the second" when an earthquake stopped the clocks on May 14, 1926.

Photograph of a Lunar Landscape.—Many textbooks of descriptive astronomy contain pictures of 'ideal' lunar landscapes, which in most cases are more or less imaginary ; but in *L'Astronomie* for April, M. M. Darney reproduces a portion of a photograph taken on Feb. 12 with the 22 cm. equatorial at the Paris Observatory ; it contains the region near the limb in the neighbourhood of Newton and Grimaldi, and is so oriented that the landscape appears much as it would be seen from a distant lunar aeroplane. The slopes of the hills are seen in their true proportions ; the steepest slopes in the region appear to be about 45°, but most of them are much more gentle. One mountain is a simple cone without any accompanying ring ; but the ring formation greatly predominates, and most of the rings appear absolutely regular and unbroken. M. Darney notes that it would be useful to take photographs of this kind of the regions that are generally invisible, but are occasionally brought into view at extreme libration. Mr. H. G. Tomkins is making a photographic study of the moon at his observatory at Dedham, and has photographed some of these little-known regions. One picture, exhibited at a meeting of the British Astronomical Association, showed a mountain with a curious appendage, resembling on an enormous scale some of the great stone blocks that have been lodged on terrestrial mountains by glacial action.

Research Items.

Cave Art in Palestine.—In *Man* for May, Miss D. A. E. Garrod figures and describes three objects of mesolithic age from the cave of Mugharet-el-Wad, which lies at the foot of Mount Carmel. The cave consists of a large well-lit chamber and long inner corridor facing north-west and commanding a wide view of the plain. In November 1928 it was found by means of trial trenches that the cave contains a very abundant microlithic industry, without associated pottery, closely resembling the mesolithic industry found at Shubka in western Judæa in the spring of 1928. In association with this industry Mr. Lambert, the excavator, found a carved bone and pierced shoulder blade. The carving represents a young cervine animal fashioned partly in the round and partly in relief at the end of a fragment of some fairly large long bone. The head is thrown back, possibly in the act of sucking, and the detail of the head is beautifully rendered. The large eyes with well-marked tear glands are very typical of the young deer. Both ears are present. The legs are carved in low relief on the shaft of the bone and show two series of horizontal incisions at the joint. There are also a series of parallel notches on the breast, possibly intended to represent loose skin. The shoulder blade which was found has a large elliptical hole cut through the thick part of the bone, close to the articular end. It recalls the *baton de commandement* of western Europe. The British School of Archæology took over the excavations from May to July 1929. It was found that the archæological sequence is Early Bronze, Mesolithic, Upper Palæolithic, Capsian, Middle Aurignacian, Early Middle Aurignacian, Mousterian—the most complete prehistoric sequence yet discovered in Palestine. At the base of the Mesolithic was discovered a crude representation of a human head shaped from a fragment of compact banded impure calcite—the first work of art of the Stone Age to be discovered in Palestine.

Nature of Purposive Movement in Fishes.—Under this title Mr. Herbert O. Bull, biologist at the Dove Marine Laboratory, Cullercoats (Report for the year ending June 30, 1929), whose most recent work on the subject has just appeared in the *Journal of the Marine Biological Association* (vol. 16, No. 2, March 1930), discusses the importance of such experimental work in providing information upon the factors which direct fishes in their purposive movements and so tend to explain their spawning and feeding migrations. He shows from his own work how the common shanny, *Blennius pholis*, in a very short time is able to react purposively after suitable training towards a gustatory stimulus containing so little as 0·00075 per cent of its food substance dissolved in sea water. With regard to those researches the author states : " I now believe that it is in this diection, or in the one closely allied to it, that we shall find an answer to many of our big problems in animal behaviour, *but only if the utmost care is taken with the smallest practical details.*"

Herring Researches at Cullercoats.—In the Report for the year ending June 30, 1929, of the Dove Marine Laboratory, Cullercoats, Northumberland, edited by Prof. A. Meek, Director of the Laboratory, most of the space is taken up by the herring investigations. Mr. B. Storrow continues his work on the same lines as in former years. The East Anglian fishery in 1928 was so successful that the merchants had completed their cure before the season was finished. This was due to the rich year classes of 1925 and 1922. The younger fishes arrived first and many of them were spawning. The 1922 class, chiefly full fish, which arrived later, was also very abundant. Its possible wealth was predicted in this report seven years ago. The advent of large numbers of fish in 1927 which had joined the commercial shoals in their third year followed an abnormal flow of Gulf Stream water into the North Sea in 1926, similar to one in 1920–21 which was followed by certain alterations in behaviour of the herring shoals. There is apparently a tendency since 1920–21 for North Sea herring to migrate towards the ocean at the approach of maturity, taking the fish away from the ordinary fishing grounds. The greatest growth occurs with oceanic conditions. In Part 2 of the herring work Mrs. Cowan continues her studies on the measurements of the fish.

Neuro-muscular Mechanism of the Gill of *Pecten*.—Under this title (*Quart. Jour. Micro. Sci.*, vol. 73, February 1930) Setna gives an account of an experimental and histological investigation of the gill of this mollusc. The bases of the gill-filaments are provided with two sets of non-striated muscle fibres which are responsible for the movements of the lamellæ. The connexions between ordinary and principal filaments contain muscle cells by means of which the movements of the filaments are brought about. Each gill has four main longitudinal nerve trunks which are derived from the brain and the visceral ganglion. A subsidiary branchial nerve not previously recorded in molluscs is described. A branching network of nerve cells and fibres comparable with those of the mantle is scattered over the cenidial axis and the principal fibres. The neuromuscular mechanism of the gill is more or less independent of the rest of the body, for the principal responses may be obtained in the isolated gills. The different movements of the gills in response to various stimuli are described and their significance to the feeding habits discussed.

Pepper Cultivation.—A general account of the history and cultivation of the pepper plant has been published by M. G. Kidavu and P. A. Venkateswaran (*Bull.* 98, Agri. Dept., Madras). Pepper, one of the earliest-known spices in the world, is indigenous in India and was first cultivated on the Malabar coast. It was one of the most important articles of trade with Europe during the Middle Ages, although it was recorded there much earlier. Being a strictly tropical plant, with the jungle as its natural home, pepper requires a heavy rainfall, and when brought under cultivation thrives best on a well-drained, virgin red laterite soil containing plenty of humus. It is a perennial climbing plant propagated by cuttings. The standards upon which the vines are trained may either be dead or living, but if the latter, it is important that care should be taken to select suitable plants, those, for example, with a deep rooting habit being essential so as to avoid competition for the surface soil water and nutrients. Regulation of shading, and attention to terracing or other forms of cultivation to minimise soil denudation during the rainy season, are other important factors in pepper growing. The necessity for manuring is only beginning to be considered, but it is already clear that the addition of humus of some kind is very beneficial. In order to avoid disease, attention to drainage and the healthiness of young cuttings, and regular spraying with Bordeaux mixture are recommended. The berries, after being thrashed from the spikes by treading, are dried on

mats or in prepared yards, both black and white pepper being obtained from the same plant, but prepared differently. As regards the economic aspect, pepper is a paying proposition, since after the initial outlay the annual expenditure is small. Uniform bearing begins about the fifth or sixth year and the maximum yields are obtained from ten- to twenty-five-year-old vines, although with careful cultivation still older plants can be profitably grown.

Petrology of the Izu Islands, Japan.—In the *Bull. Earthquake Research Inst.*, Tokyo, Sept. 1929, H. Tsuya gives a detailed account of the island volcano Kozu-shima and its rocks and discusses the geological and petrological relations of the Seven Izu Islands and the Izu Peninsula. It is shown that the liparitic rocks of the Nii-jima group (1) are not older than the more basic O-shima group (2), both types of lavas having been extruded more or less alternately. Whatever the genetic relations may be, there is now no intermediate rock type linking the two together. They appear, therefore, to be of independent lineage. Within each group the sequence of extrusion is as follows: *Izu Peninsula*: (*a*) Potash-liparite → dacite → plagioliparite; (*b*) Propylite → andesite → basaltic andesite. *Izu Islands*: (*a*) Potash-liparite → plagioliparite; (*b*) Basaltic andesite. It is noteworthy that while the liparitic rocks have become progressively richer in silica, the ratio of K_2O to Na_2O has decreased. The other series has become steadily more basic. In these the ratio of FeO to MgO in pyroxene increases with the albite proportion in plagioclase.

Core Drilling Bituminous Sands.—An interesting point in connexion with methods of separation of bitumen from impregnated sands arises from recent work carried out in Alberta for the location of these deposits beneath overburden. In the course of drilling through unoxidised bituminous sand, the action of cold water promoted a ready separation of the bitumen from its host, and as much as 96 per cent bitumen was recovered from one sample by scraping it from the cable-tool bit. Where the bituminous sand has been exposed to the action of the weather for any time, separation is not so readily effected; but it is a fact that most separation processes have been based on material taken from outcrop, that is, subject to atmospheric action. It would be a point of both scientific and economic importance to know what resistance to separation is manifest by bitumen which has been made to impregnate sand the constituent grains of which are coated to a greater or lesser extent by limonitic films: whether, given the same degree of bituminous saturation, a non-ferruginous sand (for example, glass sand) or a strongly ferruginous sand would give up its hydrocarbon content to water-flush more readily. Alternatively, it may not be a question of the sand-grain coating at all: possibly the facility of separation is a function of the freshness of the bitumen itself, for clearly where this material is exposed to the atmosphere, it undergoes changes which cannot be set up so long as it is hermetically sealed from the influence of meteoric water. One cannot help feeling that both possibilities must be taken into account. The report by S. C. Ells (Canada, Dept. of Mines, 1929) dealing with the exploitation of these sands gives point to this matter from the observations made while actually drilling, but the author does not discuss the significance of it in the sense outlined above.

Rainfall of the World.—A new rainfall map of the world is given with a paper by Dr. E. Ekhart in *Petermann's Mitteilungen* (Hefte 3/4, 1930). The map, which is printed in colour, shows seven isohyets valued in centimetres. It is based on the ten years' observations from 1911 to 1920 inclusive from more than six hundred stations ranging from Greenland and Spitsbergen to South Georgia and the South Orkneys. A noteworthy feature of the map, in which respect it differs from many other rainfall maps, is that the isohyets are not confined to the land areas, but are carried across the oceans. By the judicious use of island stations this method has been made possible without the risk of great inaccuracy. The paper contains also a number of profiles of rainfall drawn across the world on every tenth parallel of latitude from 70° N. to 60° S.

A Steel Triangulation Tower.—A portable but rigid steel triangulation tower which has been adopted by the United States Coast and Geodetic Survey is described by the inventor, Mr. J. S. Bilby, in *Special Publication* No. 158 of the Coast and Geodetic Survey. The Bilby steel tower, as it is now named, consists of an inner tower 90 feet in height and an outer tower 100 feet in height. The inner tower is to support the instruments and the outer tower to hold the observers' tent and a lamp for distant sighting. The two are not connected, and each is fixed in 5-foot anchor posts. Both are triangular in section, and are built of galvanised steel rods of convenient length. The total weight of the tower, including anchors and anchor-sills, is not more than five thousand pounds. The rigidity is such that a wind velocity of 20 miles per hour will not cause the top of the inner tower to vibrate in azimuth more than 10″. If necessary, one or more of the lower sections of the tower can be omitted when the full height is not required. Full details of construction and anchoring are given in the pamphlet.

New Magnetic Charts for France.—In 1920 the Section of Terrestrial Magnetism and Electricity of the Geodetic and Geophysical Committee for France initiated a new magnetic survey of the country, which was commenced in 1921 and completed in 1927; the general tables of magnetic elements for the 1328 stations surveyed, reduced to the epoch 1924 January 1, are now published in vol. 7 of the *Annales de l'Institut de Physique du Globe de l'Université de Paris*. The results are also embodied in a series of isomagnetic charts for the elements *D*, *I*, *H*, *F*, *X*, *Y*, *Z*. The previous magnetic survey of France, undertaken by Moureaux, was referred to the epoch Jan. 1, 1896, and comprised 617 stations. In a brief description accompanying the charts, it is stated that the secular magnetic variation between 1896 and 1924 is by no means uniform over France, being, indeed (for *H*), twice as great in Brittany as at Paris. A detailed discussion of this and related questions is to follow later.

Calibration of Tuning-forks.—The February number of the Bureau of Standards *Journal of Research* contains a paper by C. Moon on the precise calibration of a tuning-fork by comparison with a pendulum. The comparison has been made photographically, the arrangement of apparatus being such that a single film records both the frequency and amplitude of the fork, and the amplitude of the pendulum, without affecting either the vibration of the fork or pendulum, or the driving mechanism of the fork. The time taken by an integral number of vibrations of the fork has been determined to 20 microseconds, and the results exhibit quite definite small changes in the frequency of the fork consequent on changes in its amplitude

when the driving power is cut off. The relation between frequency and amplitude is closely linear, the magnitude of the changes involved being such that a fall in amplitude of a heavy steel fork from 2·3 mm. to 0·6 mm. was accompanied by a rise in frequency from 99·976 to 99·984 cycles per second. The results obtained have apparently reached the ultimate accuracy possible with this, or perhaps with any method, since there is evidence of lack of perfect isochronism in either the fork or the pendulum. The irregularity is thought to be due to a variable rate of the pendulum caused by microseismic vibrations of the building, but it is unlikely that this can be eliminated by working elsewhere, since work carried out by the U.S. Coast and Geodetic Survey (in 1894) has shown that even in such an isolated place as the summit of Pike's Peak an initially stationary short pendulum rapidly takes up a slight oscillation, the magnitude of which, in the instances mentioned, was sometimes in the neighbourhood of two minutes of arc.

Raman Effect and Chemical Structure.—In a lengthy paper in the *Berichte der deutschen chemischen Gesellschaft* for February, Messrs. Dadieu and Kohlrausch describe the method which they have used for measuring the Raman effect upon nearly a hundred compounds and discuss the bearing of the available data upon chemical constitution. It is shown that certain well-known chemical groupings are characterised by definite frequencies. The last section deals with an attempt to find a suitable mathematical expression for the experimental results. It is recognised that measurement of Raman frequencies gives us an excellent means of expressing accurately the effect of inter-atomic vibrations within the molecule, since the disturbances measured are due to vibrations of atoms or atomic groups rather than to vibrations of molecules or electrons. Moreover, the lack of sensitiveness to changes in physical state renders generalisation upon problems of constitution much simpler than is the case with such physical properties as absorption spectra or molecular refraction. Amongst the compounds to which special attention is given are carbon monoxide and benzene. Carbon monoxide is clearly differentiated from the carbonyl grouping in organic compounds, a fact which is adduced to support the view that the two atoms in the gas are held by a triple bond. The structure of benzene has already given rise to much speculation in the past. The evidence of the Raman effect is, on the whole, in favour of Kekulé's formula, since the frequencies which characterise all the various linkings in the skeleton C =CH – C are identified. But benzene possesses an additional frequency, which apparently coincides with one associated otherwise only with normal paraffins. This line disappears when a substituent enters the nucleus unless the structure of the substituent itself can produce it, and it is suggested (i) that it may owe its origin to the complete symmetry of the unsubstituted nucleus or (ii) that the six hydrogen atoms are not all equal in value, but that one of them is different from the rest. The authors admit, however, that neither of these explanations is entirely satisfactory.

Cost of Underground Electrical Mains.—Electrical engineers have generally considered that the cost of underground mains for transmitting electrical power was much more expensive than overhead wires. In a recent paper to the Overhead Lines Association, published in the *Electrical Times* for Mar. 27, Dr. Ekstrom gives costs which apparently prove that for pressures not exceeding eleven kilovolts—that is, the voltage which has been standardised for rural electrification in Great Britain—the underground mains may be much the more economical. The saving is effected by using a special cable-laying machine. This machine consists of four parts: A ditch digger which digs a trench 18 inches wide and any depth up to five feet; a belt conveyor which carries the earth dug up to a swinging spout behind the machine, where it is poured back into the trench; the truck carrying the cable, which is drawn by the digger and rolls down the loose earth; and the cable conveyor which carries the cable from the drum on the cable truck to the open part of the trench behind the digger. The machine is driven by a four-cylinder Diesel engine and its weight is so balanced that the uniform pressure on the earth under the caterpillar tracks is only 5 pounds per square inch. Eight speeds are available, four for the work of cable-laying and four for travelling. The digger advances at rates varying from 200 ft. to 300 ft. per hour and is able to cover two miles per hour in travelling from place to place. It is possible to lay a maximum of about one and a half miles of cable in an eight-hour day. The machine has been successfully used in Sweden and a film was shown of it in operation. In making his computations, Dr. Ekstrom assumes that the capitalised cost of wayleaves is about £32 per mile.

Concentration of Hydrogen Peroxide.—Whilst it is fairly easy to obtain hydrogen peroxide of moderate strength by evaporation methods, the production of 90 per cent material has so far involved rather complicated vacuum distillation. In the March number of the *Journal of the American Chemical Society*, Hurd and Puterbaugh describe a method of obtaining concentrated peroxide which consists in adding to the aqueous material about twice its volume of an immiscible hydrocarbon such as xylene or *p*-cymene. With xylene, the commercial 3 per cent peroxide can be concentrated to about 30 per cent strength, whilst by using *p*-cymene and distilling in vacuum the 30 per cent peroxide may be concentrated to 90 per cent. The vacuum of an ordinary water pump was used, the water and hydrocarbon being distilled off and more than 60 per cent of the peroxide used being left in the flask in the concentrated state. Most of the remaining peroxide is found in the distillate and 91-98 per cent recovery was obtained when the distillation temperature was kept below 57°. The material could then be frozen to obtain pure peroxide.

Atomic Structure.—We have received from Dr. W. Tombrock, of Bergen op Zoom (Holland), an article which he has published on the chemical atom in the conception of discontinuous matter, in which the structures of hydrogen, helium, lithium, and carbon are discussed. It is assumed that the electron is a material particle of larger volume and the proton a whirl in an ether composed of simple atoms. The coupling of the protons in a chemical atom alone is explained in terms of the coupling of protons in a common path of secondary orbits of motion set up by the protonic whirls, these secondary orbits appearing as circular whirlwinds round the primary protonic centres of motion. They at the same time explain the circular or elliptical motions of the spinning electron. Representations of such proton couplings are given for hydrogen, helium, lithium, and carbon. In the case of the carbon atom, the 12 protons are coupled in groups of three and have other mutual couplings. The carbon proton triad must have become stable through its combination with three other triads, thus forming the configuration of the van 't Hoff tetrahedron. Ether streams through inwards at the centres of the four faces and outwards at the four corners, or vice versa.

Royal Society Conversazione.

THE first conversazione this year of the Royal Society was held at Burlington House on May 14, and numerous specimens and pieces of apparatus were available for inspection by the fellows and their guests.

The National Institute for Medical Research (Capt. S. R. Douglas and Dr. Wilson Smith) showed specimens illustrating the effects of infectious ectromelia, a hitherto undescribed virus disease of mice. The disease was recognised by the occurrence of swelling, usually of one hind foot, followed by gangrene and separation of the affected portion of the limb. The death-rate is high, and post-mortem examination shows changes of the liver and spleen. Cytoplasmic inclusion bodies occur in the epithelial cells of the skin of the feet, and in glandular cells of pancreas and salivary glands. The disease was investigated by Miss J. Marchal, who found it to be due to a virus which, under certain conditions, constantly passes through filters which hold back bacteria.

The Department of Zoology, British Museum (Natural History), had two exhibits. Mr. H. W. Parker and Lieut.-Col. J. Stephenson showed an example of parasitisation of the frog *Phrynomerus microps* by the Oligochaete worm *Nais bauchiensis*, which was recently described before the Linnean Society (NATURE, April 19, p. 621). Mr. G. C. Robson showed a model (× 2) of *Bathothauma lyromma*, Chun, a remarkable pelagic cephalopod. *Bathothauma* is the most highly specialised of all the ten-armed cephalopods. The only known specimens were obtained in 3000 metres off the Cape Verde Islands by the *Valdivia* Expedition, and in the Pacific.

The Rothamsted Experimental Station (Dr. J. Henderson Smith) had a demonstration of virus disease in plants. Examples were shown (*a*) of the same virus in different host plants ; (*b*) of different viruses in the same host plant ; (*c*) of the combination of two viruses in the one plant. The intracellular inclusions characteristic of many virus diseases in animals as well as plants were illustrated. The movement of virus within the plant does not normally take place in the water or transpiration stream, or across dead tissues. Prof. H. Raistrick showed apparatus used for the quantitative study of the metabolic products of the lower fungi. About 400 species of the lower fungi have been grown on a synthetic medium containing glucose and mineral salts, and metabolic products arising from glucose were shown. The Low Temperature Research Station, Cambridge, had exhibits illustrating the formation of methæmoglobin in red muscle and the control of fungal wastage in citrus and other fruits by storage in an atmosphere containing acetaldehyde. The rate of oxidation of hæmoglobin to methæmoglobin in red muscle depends on the pressure of oxygen, and is a maximum when this pressure is small. In a superficial layer of muscle, the oxygen pressure is determined by the rate of diffusion of oxygen into the tissue and the oxygen consumption of the tissue. In consequence, the discoloration of red muscle produced by the formation of methæmoglobin can be controlled by alteration in the oxygen pressure of the gas surrounding the tissue. The Forest Products Research Laboratory (Department of Scientific and Industrial Research) illustrated the use of anatomical methods in investigating the technical properties of timbers. The magnified image of a transverse section of the sample of wood is projected on to a screen and a pointer moving across the field records on two scales according as it is moved over a group of fibres or over other elements. Calculation gives the percentage of fibres in the sample.

Dr. and Mrs. Pole Evans showed a striking collection of illuminated coloured transparent photographs of the natural vegetation of South Africa. The photographs were coloured by hand by Mrs. Pole Evans, and show natural vegetation scenes of grassland, forest, and desert, and included a number of photographs of the Kalahari, showing clearly that this region is anything but a desert in the commonly accepted sense. In the desert scenes, the two most remarkable plants in southern Africa are shown : (1) The plant commonly known as the ' Elephant's trunk ' or ' half mens ' (*Pachypodium namaquanum*), a unique plant which occurs in the mountains of the Orange River Valley ; and (2) *Welwitschia mirabilis*, which is only found in the deserts of western Africa. The John Innes Horticultural Institution had preparations showing the chromosomes of diploid and tetraploid plants of *Primula sinensis* and *P. obconica* and others illustrating ' illegitimate ' pollinations (pin-eye with pin-eye forms and thrum-eye with thrum-eye) in *P. obconica*, showing that the pollen-tubes fail to enter the stigmatic tissue. Preparations were also shown of chromosomes of *Pyrus Malus*. The set of 17 is made up of seven types, four of which are represented twice and three three times. This unbalanced polyploid condition explains some of the special properties exhibited by the group.

The Department of Geology, British Museum (Natural History) (Mr. A. Tindell Hopwood), showed teeth of *Synconolophus* Osborn. This genus of mastodons, found in the Lower and Middle Siwaliks of India, may have ranged so far west as the Isle of Samos, though the evidence is not clear ; but it is not yet known from China or from Burma. The Museum also showed a skull and feet of *Diceratherium Cooki*. This rhinoceros had two horns side by side on the nose. Various species have been found all over western Europe and North America, and this particular one from Nebraska was small, little larger than a pig, and with somewhat the same proportions.

Mr. R. S. Whipple showed an early Italian globe—believed to be the only example known. It consists of two hollow hemispheres joined internally by ' bayonet ' clips and measures 9·5 cm. in diameter. In a dedicatory inscription it is stated that the globe was engraved by Paolo de Furlani, a well-known engraver and seller of maps at Venice in the second half of the sixteenth century.

The Radcliffe Observatory, Oxford, exhibited photographs of the new planet discovered at the Lowell Observatory. The two enlargements shown were from plates taken on Mar. 29 and April 2, with exposures of an hour. The instrument employed was the 24-in. refractor by Grubb.

Prof. E. N. da C. Andrade illustrated the mechanism of ridge formation in a sounding tube. A sphere in a sounding tube is actually the centre of a vortex system, which governs the arrangement of neighbouring spheres. Three tubes, excited by valve circuits were shown ; (1) formation of ridges with particles of cork dust ; (2) method of formation in more detail, with light spheres a few millimetres in diameter ; (3) vortex system round a single sphere. Messrs. Adam Hilger, Ltd., showed spectrographic equipment, including apparatus for the observation of fine structure. A photograph taken by Mr. D. A. Jackson on

a reflection echelon of fused silica with the plates platinised was shown; the reflection echelon used is of the type suggested by Mr. W. E. Williams in which the reflecting plates of fused silica are mounted in optical contact. Number of plates—25; thickness of plates, 7½ mm. The resolving power for wave-length 4000 A. is 913,000. There was also a Fabry-Perot etalon of variable separation designed by Mr. F. Twyman, for measuring wave-lengths in the longer wave-length region of the spectrum in terms of the red cadmium line or other standard lines, and for observation of the fine structure of spectrum lines towards the red end of the spectrum. A spectrogram from 1850 A. to 3650 A., obtained on a perfectly flat photographic plate by means of an improved quartz lens system, designed by Mr. J. W. Perry, was also exhibited. The Research Laboratories of the General Electric Company (Mr. J. T. Randall and Mr. H. P. Rooksby) showed X-ray photographs and crystal models illustrating the structure of vitreous and amorphous solids. The passage of X-rays through glass gives rise to broad diffraction rings or bands. Some recent results (NATURE, Mar. 22, p. 458) indicate that these bands can usually be accounted for if it be assumed that the glass consists of very small crystallites.

The Department of Mineralogy, British Museum (Natural History) (Dr. L. J. Spencer), showed specimens of zinc-blende from Tsumeb, South-West Africa, which exhibited triboluminescence to a marked degree, even when under water; it also showed brilliant fluorescence when exposed to ultra-violet rays. The Research Department, Woolwich, illustrated a method for examining for flaws visually by means of X-rays, long cylinders, such as gun tubes or gas cylinders. A fluorescent screen is viewed at a distance and suspicious marks on the interior face of a long tube may be first identified by ordinary illumination and then by the interposition of a screen. The same area may be irradiated by X-rays and viewed on a fluorescent screen.

The Solar Physics Observatory, Cambridge, and the Cambridge Instrument Company, exhibited a recording microphotometer, designed for the study of spectrograms and photographs up to a size of 12 in. × 10 in. Light from an incandescent lamp is concentrated on to a minute area of the plate and the transmitted light falls on a slit over a photo-electric cell. The photo-electric current passes through a Koch resistance cell and the potential across this cell is measured by a Lindemann electrometer. The pointer of the latter is projected on to the camera (bromide paper 500 mm. long × 120 mm. wide), and its movements correspond to the density changes which are taking place in the plate as it is traversed. The plate is mounted on a carrier with three degrees of freedom, the whole carrier being moved by a motor-driven screw, which also rotates the drum of the camera, so that the movement of the latter bears a definite relation to the movement of the plate. Two ratios are provided, 10 to 1 and 50 to 1. The part of the plate under examination can be viewed in a separate microscope while the record is proceeding. Absorption wedges are provided, so that calibration lines can be made on the record or the density of any line measured by a null method. Tracings were shown which give (*a*) an analysis of the shape of the absorption lines of sodium (*D* lines) in the solar spectrum; (*b*) an analysis of the shape of the absorption lines of hydrogen (Balmer lines) in stellar spectra; (*c*) distribution of illumination in the nebula N.G.C. 3115, this being applied to form a contour map of brightness in the nebula. The National Physical Laboratory had several exhibits. The Physics Department showed a multiple thermoelement type hygrometer devised for use on ships carrying refrigerated cargoes. The thermojunctions are housed in a metal casing attached to the end of a hose pipe and this is lowered down a thermometer tube. A stream of air is drawn past the junctions by a suction fan attached to the other end of the pipe. The Metrology Department showed apparatus for friction and wear tests on pivots and jewels. The pivot is mounted in a vertical spindle, and supports a disc by means of a jewel mounted at the centre of the disc. The disc can be maintained stationary by means of a magnet lying on the upper surface of the disc whilst the pivot rotates. The apparatus has eight spindles, so that eight tests can be carried out simultaneously. Wear of the pivot and jewel surfaces occurs as the pivot rotates, and this increases the torque due to friction between the pivot and jewel. The apparatus can also be used to measure this torque at any time during the progress of a wear test. The Wireless Division illustrated work which has been carried out for the Radio Research Board of the Department of Scientific and Industrial Research. A demonstration was given by the projection of a spot of light on a screen of the frequency analysis of a modulated continuous oscillation. The method of taking aural observations of bearings on the Orfordness rotating wireless beacon was demonstrated with the aid of a special stop-watch. The beacon signals can also be recorded automatically on a drum rotated synchronously with the beacon. A 1-kilowatt two-valve transmitter suitable for generating oscillations on wave-lengths between 4 and 10 metres was shown, and also a simple portable two-valve receiver suitable for reception work on the same range of wave-lengths. The Building Research Station (Mr. A. F. Dufton) exhibited a microvolt-hour meter for the investigation of the flow of heat at a window, into or out of a room (NATURE, April 26, p. 635).

Sir Robert Hadfield exhibited numerous specimens illustrating special properties and applications of ferrous alloys. An electric furnace was shown in operation with heating elements of the new R.H.* heat resisting alloy. This alloy has the high electrical resistance of 134 microhms per c.c. at 20° C., with a low and uniform temperature coefficient of 0·000075 per ° C.; this combined with remarkable resistance to heat scaling. By its means furnaces of the resistance type can be maintained continuously at temperatures as high as 1200° C. Specimens were shown illustrating the difference in the effect of mechanical deformation on (*a*) manganese steel; (*b*) steel containing high percentages of nickel and chromium. Both in their ordinary conditions are non-magnetic; while, however, the non-magnetic property of the former is unaffected by cold work, the latter is rendered fairly strongly magnetic. Another exhibit was a specimen excavated from the base of the Khan Baba Column, in the Bhilsa district of Gwalior State, India, dating about 30 B.C., certain portions of which contain no less than 0·70 per cent of carbon. Upon heating to 830° C. and quenching in water, the high carbon part acquired a glass-scratching hardness, the Brinell hardness figure being 652, showing that no time effect wipes out this remarkable quality of hardening by quenching.

Mr. L. S. B. Leakey demonstrated the Leakey-Harper drawing machine, originally designed to facilitate the detailed drawing of human skulls. The machine is suitable for drawing any objects of which an accurate drawing is required, such as fossils, pottery, palæolithic instruments, etc. Among other great advantages is the fact that drawings of several different views can be made without touching the object.

Early Copper and Bronze in South Africa.

TWO papers dealing with the primitive working of copper in South Africa, which were presented to Section H at the South Africa meeting of the British Association, are printed in full in vol. 26 of the *South African Journal of Science*. The late Dr. P. A. Wagner and Mr. Hugh S. Gordon deal with material obtained from ancient smelters on the farm Blauwbank, No. 435, in the Waterberg district of the Transvaal, from which it was deduced that the ancient metallurgists had deliberately set out to make bronze. Further, as the original ingot found on the site some years ago and the prills of bronze here dealt with contain nickel and arsenic in notable amounts, it has been suggested that investigation might throw light on the date of these workings in view of the fact that ancient bronze from Egypt and Mesopotamia contains nickel, and yet no very ancient site is known which could have produced the ore required to make a nickeliferous bronze.

Further investigations have established the existence at Blauwbank of no fewer than forty smelting sites, two different types of furnaces, and at least four different types of slag, proving that tin, iron, copper, and bronze were smelted there. Chemical analysis of eleven of the supposed bronze prills and brods prove that some of them are of fairly pure copper, others of arsenical copper and copper spice, while only two contain enough tin to bring them within the definition of true bronze, and these are so rich in arsenic that the application of the term is scarcely warranted. Nearly all contain some percentage of nickel. The analysis of a bronze bangle from Zimbabwe also contains nickel. As other bronzes from Zimbabwe and a piece of bronze from Rooiberg, found by Dr. Frobenius, also contain nickel, it is possible that further investigations may show a connexion between Blauwbank and Rhodesia, especially as no ancient tin-workings are known in Southern Rhodesia.

On the other hand, Mr. G. H. Stanley in a paper on "Primitive Metallurgy in South Africa", while admitting that the specimens he has examined point to a deliberate admixture of tin and copper, holds that the copper ingots are of recent native origin. The specimens from Zimbabwe which were examined were in part from the Rhodesia Museum, Bulawayo, in part specimens submitted by Miss Caton-Thompson from her excavations at Zimbabwe and other ruins of Rhodesia. The museum specimens from Zimbabwe itself were typical tin bronzes approximating so closely to the 90:10 ratio that in all probability they were made by melting together previously smelted copper and tin. No nickel was found in any, though there were traces of cobalt. The metal was of excellent quality and obviously produced by skilled smelters from very fine ores. Of the specimens from other sites, a slug from Renders Ruin was almost pure copper, while a bangle from Niekerk Ruins, Inyanga, contained less tin and more arsenic than the rest. A spear-head from Dhlo-Dhlo was of intermediate position, but with neither nickel nor cobalt in detectable quantities.

Miss Caton-Thompson's specimens—small objects, bangles and the like—exhibited a peculiar blue-green patina which suggested enamel. It was, however, easily removable by dilute hydrochloric acid, leaving a very roughly corroded surface. A bangle gave the analysis copper 87·43, tin 12·3, iron 0·08, nickel nil, cobalt faint trace. A spherical pellet 1·4 cm. in diameter showed copper 98·87, tin 0·8, bismuth 0·01, nickel nil, cobalt nil. Other bangles gave an analysis of copper 89·57, tin 10·5, and a piece of thin bronze plating gave approximately the same.

Excepting a brass, the only specimen to show a notable content of nickel was a specimen from Chiwona, an irregular flattened lump of metal weighing about 110 gm., evidently a smelting product. The analysis was copper 96·3, arsenic 1·78, tin trace, iron 0·42, nickel 1·2, cobalt slight trace.

Mr. Stanley maintains that the presence of nickel is exceptional rather than characteristic. Nickel is quite a common accompaniment of copper in ores of the latter, but unless its presence is commercially important, it is not usually determined or reported. The analyses of ancient copper objects from Sumeria published by Prof. Desch show only four with nickel exceeding 0·25 per cent, the richest being 3·3. Copper and bronze objects of ancient Egyptian and Babylonian origin seldom show the presence of nickel beyond what might be considered an ordinary impurity. In regard to the possibility of South Africa having been the source of ancient bronzes showing traces of nickel, he holds that such ores might have been obtained from a number of other centres, such as the Caucasus or Asia Minor, where a number of ancient workings are known, and others are probably still undiscovered.

University and Educational Intelligence.

CAMBRIDGE.—The Ministry of Agriculture and Fisheries has offered to make a grant not exceeding £8500 in aid of the provision of additional laboratory accommodation at the field station of the Department of Animal Pathology in the University.

The Appointments Committee of the Faculty of Economics and Politics has appointed E. A. G. Robinson, of Corpus Christi College, to be University lecturer in the faculty.

The Council of the Senate has recommended the establishment of a temporary professorship of colloidal physics for three years, and that the professorship be held in the first instance by Dr. E. K. Rideal, of Trinity Hall.

It is proposed to confer the honorary degree of doctor of science on Prof. A. Einstein, Prof. M. Planck, and Sir John Rose Bradford.

At a special congregation of the Senate on May 17, the Right Hon. Stanley Baldwin was elected Chancellor of the University in succession to Lord Balfour, who died on Mar. 19.

LEEDS.—The Corbet-Woodall scholarship in gas engineering, value £60 a year, and tenable for three and possibly four years, is being offered for competition. Applications must reach the Clerk to the Senate, the University, Leeds, by June 2.

LONDON.—Presentation Day at the University was on May 14, the ceremony taking place in the Albert Hall. The new Chancellor, Lord Beauchamp, who presided for the first time, referred in his charge to the new graduates to the re-constitution of the University under the Act of 1926. In the course of next year, he said, it might be expected that the foundation stone would be laid of the buildings on the Bloomsbury site, into which the University would enter in its centenary year (1936). Another important development to which the Chancellor specially referred was the provision of a hall of residence for students. The new Principal, Dr. E. Deller, in his Report, also referred to the re-constitution. "There are still some matters outstanding—the revision and (it is hoped) the simplification of our regulations, and the delegation of powers are examples—but satisfactory progress is being made." The total number of candidates for

all examinations, the Report stated, was 36,633 as against 11,937 in 1913 and 34,941 last year. The candidates for first degrees were 3436 and for higher degrees 510. Of the 3436 candidates for first degrees, 2458 were internal and 1488 external students. There are now 10,200 internal students. Nothing of outstanding scientific interest is included in the Report, but among recent developments reference is made to the establishment of the University Observatory at Mill Hill Park and to the institution of a chair of social biology at the London School of Economics.

MANCHESTER.—Notice is given of the offer of a Grisedale research scholarship in either botany or zoology, the value of which is £200. Applications should reach the Registrar of the University by June 2 at the latest.

SIR WALTER BUCHANAN-RIDDELL, principal of Hertford College, Oxford, has been appointed by the Lords Commissioners of the Treasury to be chairman of the University Grants Committee in succession to the late Sir William McCormick.

AN examination of candidates for the associateship of the Institute of Physics will be held in September next. Applications for entry for the examination must be received by the Secretary of the Institute, 1 Lowther Gardens, S.W.7, not later than July 31.

A FELLOWSHIP of the annual value of £300, and tenable for two years, is being offered by the Company of Armourers and Brasiers, for research in aeronautics. Applications, upon a form obtainable from the Clerk, Armourers' Hall, 81 Coleman Street, E.C.2, must be sent in by, at latest, May 30.

THE Empire Cotton-growing Corporation is offering a number of (*a*) specialist studentships, and (*b*) agricultural studentships, particulars as to the tenure and value of which may be obtained from the Secretary of the Corporation, Millbank House, 2 Wood Street, S.W.1. The Specialist Studentships are intended to enable graduates who believe that they have a leaning towards research to equip themselves for posts in which work of that type is required. The Agricultural Studentships are intended to enable men to receive specialised instruction to equip them for agricultural posts in cotton-growing countries, whether in Government Agricultural Departments, with commercial cotton-growing companies, or under the Corporation. Completed forms of application must reach the Corporation by June 4.

THE Council of the Institution of Electrical Engineers has established the following scholarships, the first awards of which will be made this year: *Duddell Scholarship* (annual value £150, tenable for 3 years). Each candidate must be nominated (not later than June 15) by a corporate member of the Institution. The award is open to British subjects less than nineteen years of age on July 1, who have passed the matriculation examination of a British university or an examination exempting from matriculation: *Ferranti Scholarship* (annual value £250, tenable for 2 years). Each candidate must be nominated (not later than Aug. 15) by the professor or teacher under whom he is working or has worked. The award is open to British subjects less than twenty-six years of age on July 1 who are students or graduates of the Institution of not less than two years' standing. Particulars can be obtained from the Secretary of the Institution, Savoy Place, London, W.C.2.

Historic Natural Events.

May 25, 1269. Prolonged Winter.—The winter of 1268–69 was very rigorous in Great Britain, northern Europe, and Germany. In Alsace it was prolonged until May 25. Holinshed (1578) records that "an exceeding great frost began at St. Andrew's tide (Nov. 30) and continued till near Candlemas. The Thames, from the bridge upwards, was so hard frozen that men and beasts passed over. Ships could not enter the Thames, so merchandise was brought to London from Sandwich and other places by land." The Baltic was frozen between Gothland and the Swedish coast.

May 25, 1686. Hailstorm at Ryssel (Lille).—Hailstones fell at Lille weighing from one quarter to one pound or more on May 25, 1686. One had dark brown matter in the middle, which when thrown into the fire gave a loud report. The others were transparent and melted immediately. The storm passed over the citadel and town, and not a pane of glass was left on the windward side. Trees were broken and beaten down, and partridges and hares were killed in abundance.

May 26, 1916. Eruptive Solar Prominence.—A remarkable eruptive prominence, reaching the unprecedented height of 18′ (about 500,000 miles) above the sun's limb, was photographed in India with the spectroheliographs at Kodaikanal and Srinagar. Between $8^h\ 6^m$ and $9^h\ 9^m$ (Indian Standard Time) the prominence rose with increasing velocity from a height of 130″ to 15′. At $9^h\ 9^m$ the bulk of the prominence had suddenly disappeared, leaving a group of bright points at a height of 13′ to 17′; at $9^h\ 22^m$ or about $1\frac{1}{4}^h$ after the first photograph, this small group of points was faintly visible 16′ to $18\frac{1}{2}$′ above the sun's limb. The general movement of ascent of the prominence ranged from 80 km./sec. to 290 km./sec., whilst the greatest velocity of movements of points within it was 450 km./sec. It may be remarked that this great eruption occurred outside the sunspot zones.

May 28, 1856. Rhone Floods.—Serious flooding existed in the upper Rhone and especially the Saone on May 11–20, and the waters had scarcely begun to fall before another flood set in on May 24–26. On the evening of May 28 a general heavy fall of rain began and continued for nearly forty-eight hours; at several places totals of more than 4 inches in twenty-four hours were recorded. The floods of the Drac, the lower Isère, the upper Danube, and the Rhone at Lyons, exceeded all records, and persisted for thirty-six hours. The level rose 30 feet above normal at Beaucaire, all the dykes were broken, many bridges were carried away, and the low-lying parts of Lyons on the left bank were partly destroyed. An enormous area was flooded between Tarascon and the sea, and all the crops were ruined.

May 29, 1613. Cloudburst.—An enormous 'cloudburst' occurred in Thuringen, lasting eleven hours, and was followed by unparalleled floods, remembered for a century under the name of the "Thuringian Deluge". At the same time there were great floods in Saxony, Bohemia, and Austria.

May 29, 1919. Great Eclipse Prominence.—A great arched prominence, nearly 300,000 miles in length and more than 100,000 miles in height, was a conspicuous naked-eye object within the corona during the total solar eclipse of May 28–29—the occasion when the displacement of a ray of light caused by the gravitational field of the sun (as predicted by Einstein) was first measured. This prominence, as shown by spectroheliograms taken at Cambridge, Kodaikanal, and Yerkes, had been in existence since Mar. 22, and at the time of the eclipse

it was coming into view around the sun's east limb. Shortly after the eclipse had been observed in South America (about 2h G.M.T.) the prominence, hitherto of a stable character, became eruptive, and by 8½h G.M.T. had risen to a height of more than 450,000 miles, after which it suddenly dissipated. The two columns from which it arose in latitudes 37° and 41° S. were seen at each return to the sun's limbs for two months after the eclipse.

May 29, 1920. Louth Floods.—A thunderstorm of unusual severity broke over Lincolnshire during the afternoon, accompanied by exceptionally heavy rain over the Wold country to the west and south-west of Louth. At Elkington Hall, 3 miles west of Louth, 4·69 in. was measured, of which 4·59 in. fell in three hours, and at Hallington two miles to the southward it is estimated that 6 inches fell in three hours. The river Lud rose 16 feet in fifteen minutes and a deep torrent 200 yards wide swept through the town. The damage done in Louth alone was estimated at £100,000, while the flood came as a complete surprise to most of the inhabitants, who were sheltering indoors, and 22 persons were drowned. The flood was probably accentuated by the blocking of the valley by débris at a bridge just above Louth.

May 29, 1928. Shower of Fish.—Dozens of tiny red fish were found on the roof of a bungalow at Drumhirk, near Comber, Ireland, and on the ground in the vicinity. Just before the discovery of the fish there had been an exceptionally violent thunderstorm with heavy rain. There is no river in the neighbourhood, the nearest sheet of water being Strangford Lough, 2 miles distant, and it was believed that the fish had been lifted from the sea by a waterspout.

May 31, 1911. Thunderstorm at Epsom on Derby Day.—The severest thunderstorm and heaviest rainfall since records started in 1905 occurred between 5 P.M. and 8 P.M. at Epsom on May 31, 1911. The day had been humid and close, with a thunder haze gathering about 3 P.M. Thunder was heard and at 5 P.M. three distant storm centres became apparent north and north-east, north-west, and south to south-west. Two cloud currents were visible at 5 P.M., an upper one from south-west, and a lower one from north-east. Fork lightning and thunder were practically continuous. The thunder was in sharp decisive cracks, and the lightning of dazzling intensity. At 5.30 P.M. the north and south centres coalesced, and rain commenced falling in a torrent at 5.20 and continued until 6.0, 2·44 in. falling in fifty minutes. The thunder ceased at 7.59 P.M. but the lightning remained visible until 9.30 P.M. Seventeen people and four horses were killed, and three hayricks fired by lightning.

Societies and Academies.

LONDON.

Royal Society, May 15.—**M. L. E. Oliphant** and **P. B. Moon**: The liberation of electrons from metal surfaces by positive ions. When helium ions strike a metal surface they liberate electrons, the number depending upon the metal and the condition of its surface. Velocity distribution of electrons, liberated from a clean surface of molybdenum by positive ions of helium, shows a sharp cut-off at a lower limit of 2·3 volts, and a sharply defined upper limit at 20·2 volts. Maxima were observed in experimental curves at 2, 5, 6·8, 17·0, and 20·0 volts. The results can be explained quantitatively on the basis of modern theories of the metallic state.—**O. W. Richardson** and **U. Andrewes**: A comparative study of the excitation of soft X-rays from single crystal surfaces and from polycrystalline surfaces of graphite and aluminium. The curves obtained by plotting the photoelectric yield of the soft X-rays per unit thermionic current against the exciting primary voltage show discontinuous rates of increase at certain voltages which coincide with those which give similar discontinuities with the polycrystalline specimens. They are, however, fewer in number and tend to run in groups. The voltages at which the discontinuities occur appear to have a numerical structure resembling that which connects the null frequencies of band systems. The crystal curves are steeper at moderate voltages and flatter at high voltages than the polycrystalline curves.—**O. W. Richardson** and **S. Ramachandra Rao**: (1) The excitation of soft X-rays from some polycrystalline metal surfaces. Measurements have been made of large numbers of soft X-ray critical potentials for cobalt, nickel, tungsten and pure and also impure copper. Variation of photoelectric yield with magnitude of thermionic current and with inclination of anticathode is examined. Many of the inflections only appear after the targets have been heated to a high temperature.—(2) The excitation of soft X-rays from a single crystal face of nickel. The soft X-ray critical potentials for the 100 face are less numerous than for polycrystalline nickel. The total yield is also lower at high and higher at low voltages with the crystal specimen.—**S. Ramachandra Rao**: (1) Total secondary electron emission from polycrystalline nickel. Applied potentials from 1 to 550 volts were used. Several peaks are obtained below 30 volts and a large number of inflections above 30 volts. The effect of bombarding in hydrogen is also studied.—(2) Total secondary electron emission from a single crystal face of nickel. The potentials at which inflections appeared agree very well with the soft X-ray discontinuities from the same crystal face obtained by Richardson and Rao. The bearing on soft X-ray discontinuities is discussed.—**O. W. Richardson**: The emission of secondary electrons and the excitation of soft X-rays. The first act seems to be the excitation of a *structure* electron by the primary which is returned as part of the high energy group of secondaries. The low energy group and the X-rays result from the return of the excited structure electrons to the ground state. The agreement of the soft X-ray with the secondary electron breaks is accounted for, since both are excitation potentials of the structure electrons. The hypothesis gives a natural explanation of the band-like structure of the discontinuities already found empirically for C and Al and here extended to Ni.—**W. A. Bone, L. Horton**, and **S. H. Ward**: Researches on the chemistry of coal (6). The main coal-substance can be readily oxidised by means of alkaline permanganate to carbonic anhydride, acetic, oxalic, and benzene carboxylic acids; about one-third of the carbon of the coal substance appeared in C_6-rings of benzenoid acids. Under 'optimum conditions' the character and proportions of the various oxidation products do not vary much with the maturity and geological age of the coal, and colloidal 'humic acids' are formed as intermediate oxidation products. The constituents of bituminous coals mainly responsible for their 'coking propensities' are benzenoid in character, and in all probability during the 'maturing process' they developed from phenols and phenolic esters, found in immature brown coals. On carbonising coals at various temperatures up to 1000° C. their proportionate 'benzenoid' structure first increases, attaining a maximum at about 500° - 600° C., but afterwards diminishes, although a completely 'carbonised' coke still retains some of it.—**L. Rosenhead**: The spread of vorticity in the wake behind a cylinder. The trail of vortices in the wake behind a cylinder is taken to be a symmetrical double row of rectilinear vortices of circular

section. The stability of such a system to three-dimensional disturbances is investigated. There is also a discussion of the stability of an isolated rectilinear vortex of circular section to three-dimensional disturbances.—L. J. Freeman: The spectra of trebly-ionised oxygen (O IV) and trebly-ionised nitrogen (N IV). About 50 lines in the spectrum of trebly-ionised oxygen (O IV) have been newly classified. All the doublet and quartet terms of principal quantum number 3 have been identified. In the spectrum of trebly-ionised nitrogen (N IV), combinations of the $3p$ term with $3s\ ^2S$ and $3d\ ^2D$ have been observed. Provisional classifications have been given for four other lines.—G. Temple: (1) The group properties of Dirac's matrices. An account of the group properties of a set of operators (A_1, A_2, A_3, A_4), with operand ψ, particularly with reference to a generalised form of Dirac's wave equation

$$\sum_n^4 p_n A_n \psi + (2\pi\iota mc/n)\psi = 0,$$

in which the A's are not restricted to be matrices. (2) The operational wave equation and the energy levels of the hydrogen atom. Dirac's methods can be modified and generalised to suit an extension of his linear wave equation based on the preceding paper, which is applied to the problem of the undisturbed hydrogen atom. It proves possible to obtain the energy levels, quantum numbers, and wave functions. —J. Hargreaves: The effect of nuclear spin on the optical spectra. (3) The interaction energy of the nuclear and electron magnets is calculated for the cases of nuclear spins of $\frac{1}{2}$, 1, $1\frac{1}{2}$, and $4\frac{1}{2}$ quanta. A description is also given of the hyperfine structure of the Zeeman effect, and it is found that the 'cosine' law holds. The results agree very well with observations for bismuth.

Geological Society, April 30.—Emily Dix and A. E. Trueman: Some non-marine lamellibranchs from the upper part of the coal measures. The higher part of the *Pulchra* Zone and in the *Phillipsi* and *Tenuis* Zones are discussed. Nearly all the shells found in these higher measures are members of the genus *Anthracomya*, and most of them are related to the group of *A. phillipsi*; but there is evidence that another group, represented by shells which resemble *A. lanceolata* Hind, occurs more rarely at widely separated horizons. The sequences determined in many British coalfields are remarkably similar, and reasons are advanced for the view that at certain periods in the late Carboniferous Period there was considerable uniformity in the conditions over large parts of Britain. There are also great similarities in the sequence in the upper part of the Westphalian of the Continent.—Emily Dix: The flora of the upper portion of the Coal Measures of North Staffordshire. The paper deals with the distribution of fossil plants in the Upper Coal Measures, and in the upper part of the Middle Coal Measures of North Staffordshire above the horizon of the Ash Coal. Few plants have hitherto been recorded from the measures for some distance below the Bassey Mine Ironstone, and the chief purpose of this paper is to give an account of these measures with the view of determining the horizon which marks the entrance of the Staffordian flora in North Staffordshire. For some hundreds of feet below the Bassey Mine Ironstone the measures yield a flora in which Radstockian and Yorkian species are mingled, and therefore it is concluded that the base of the Staffordian should be drawn below the Chalky Mine Ironstone, about 400 feet below the Bassey Mine Ironstone. This conclusion is of importance in the correlation of such areas as South Wales, Staffordshire, and Somerset by means of fossil plants.

Society of Public Analysts, May 7.—L. H. Lampitt, E. B. Hughes, and H. S. Rooke: The diastatic activity of honey. Honey diastase behaves in a similar way to other enzymes under varying conditions of temperature and *p*H, the optimum *p*H for both the dextrinogen-amylase and the saccharagen-amylase being about 5·3.—A. R. Powell and W. R. Schoeller: A new method for the separation of titanium from zirconium and hafnium. The method is based on the precipitation of the titania by tannin from a neutralised oxalate solution half-saturated with ammonium chloride: a repetition of the procedure results in the quantitative precipitation of the titania with only traces of zirconia, if any.—E. R. Bolton and K. A. Williams: The composition and polymerisation of Chinese wood (tung) oil. The authors confirm the value of Toms's method of determining the elæostearic acid in tung oil by the difference between the iodine value obtained by the bromine vapour and that obtained by the action of Wijs solution until four of the six bonds are saturated. The elæostearic acid glyceride corresponded with the amount of polymerisable matter separated by the authors' method of extraction, and for the oils examined ranged from 70 to 74 per cent.—D. R. Wood: The examination of milk for tubercle bacilli. A survey is given of the experience and results obtained in the examination of 1000 herds in the County of Somerset during the last four years. Present methods are inadequate for the elimination of tuberculous milk.

DUBLIN.

Royal Dublin Society, April 29.—J. Reilly, R. Wolter, and P. P. Donovan: Study of the polysaccharides (3). Acetamide as a polysaccharide solvent.—J. H. J. Poole: A new form of recording galvanometer. A transparent scale about 4 cm. long at a distance of about 10 cm. is employed instead of the usual 50 cm. scale at 100 cm. distance. A small lamp with a condensing lens behind the scale illuminates the latter uniformly. After reflection in the galvanometer mirror, which is preferably plane, an image of a short portion of the scale is formed on a film of a Baby Pathe kinematograph camera at a convenient distance—say 20 cm.—by means of a good lens. A fine wire almost in contact with the film casts a shadow the reading of which on the scale measures the galvanometer deflection. A mechanical device which causes one exposure per minute (or at any other convenient interval) enables a permanent record to be obtained. The method is cheaper than the more usual revolving drum apparatus as it employs standard commercial articles. The camera may be replaced by an eyepiece with cross wires for direct observation. The method is then well adapted for observing the deflections of sensitive portable galvanometers for outdoor work. In this case the lamp and condensing lens may generally be omitted and the scale illuminated by daylight.

PARIS.

Academy of Sciences, April 7.—Ernest Esclangon: The new celestial body discovered at the Lowell Observatory. Data worked out from photographs taken at the Paris Observatory between Mar. 26 and April 4.—H. Deslandres: A new cause which intervenes in increasing or modifying the intensity of lines and bands in the spectra of atoms and molecules. —Marcel Brillouin: Dynamical tides with continents. The law of any depth. Attraction of the ring.—Charles Richet and Michel Faguet: The action of irradiated sea water on lactic fermentation. After ten minutes irradiation, there is an acceleration of the fermentation as measured by the acidity produced:

after thirty minutes irradiation there is an inversion, no acceleration being produced.—**C. Gutton**: The properties of ionised gases in electromagnetic fields of high frequency. The observations described confirm the explanation given by H. Gutton of the results of his researches. It is suggested that the formula of Eccles and the theories based on it require modification.—**E. Mathias**: The conception of Stephen Gray on the identity of lightning and the sparks of electric machines. In one respect the view of Stephen Gray is imperfect; lightning transports only positive electricity, whereas the induction spark is formed of two discharges in opposite directions.—**L. Léger**: *Sphœrospora pernicialis*, a new Myxosporidium pathogenic to the tench.—**J. Dieudonné**: The roots of algebraic equations.—**L. Escande**: The excess pressure caused by the stopping of a motor pump group in a water main.—**F. Baldet**: The calculation of the photometric diameter of the celestial body of the Lowell Observatory (see NATURE, May 3, p. 672).—**Jean Jacques Trillat**: Researches on the internal and superficial structure of organic liquids with long chains. The results of an X-ray study, with special precautions against the errors due to the presence of a halo arising from the filtration of the continuous background. In several cases, the superficial structure of liquids differs from the internal structure, as a result of a statistical orientation of the molecules. The results of McBain and of Hardy are confirmed.—**H. Mutel**: The measurement of the effective intensity of high frequency currents. Experiments with a differential ammeter consisting of two glass tubes arranged as arms of a differential air thermometer, with a fine platinum wire in the axis of each. One carries the high frequency current and is balanced by a direct current. Even after correction for the skin effect for very high frequencies, there is an error due to the heating of the heat insulation material by the high frequency electromagnetic field.—**J. Urbanek**: The diffusion of light by polished surfaces. A description of a photographic method serving to characterise the perfection of polishing of a vitreous surface.—**C. Marie** and **Gérard**: The electrolytic deposit of copper in the presence of amino acids. Copper deposited electrolytically from a solution of copper sulphate containing glycocoll, contains both copper sulphate and the amino acid. Leucine behaves similarly.—**Guy Emschwiller**: The photolysis of the organic iodides: the influence of temperature. The temperature coefficient of the photolysis varies with the nature of the radiation. The phenomena are complicated and experimental verification of the theories suggested to explain the existence of a temperature coefficient of photochemical reactions is difficult.—**Augustin Boutaric** and **Mlle. Geneviève Perreau**: The flocculation produced by the mixture of two colloidal solutions of the same nature but the granules of which have opposite electric signs.—**F. Bourion** and **Mlle. O. Hun**: The determination, by the boiling-point method, of the molecular equilibria of pyrocatechol in solutions of potassium and sodium chloride.—**J. Golse**: The action of silver nitrate on solutions of potassium mercuric iodide.—**A. Travers** and **Avenet**: The estimation of phenols in coke oven effluents.—**Albert Kirrmann** and **Jean Grard**: An abnormal reaction of the dihalogen propylenes. 1, 3: dibromopropylene, in a previous communication, has been shown to react in an anomalous manner with organo-magnesium compounds: the 3, 3: dichloropropylene is now found to behave similarly.—**Roger Dolique**: The normal *n*-butylbenzyl and dibenzylethyl alcohols, the isomers methyl-*n*-butylbenzyl and ethyldibenzylcarbinols.—**Mlle. M. Cabanac**: The catalytic decomposition of some acetals of the fatty series by metallic oxides. Diethylacetal, at 400° C. in the presence of thoria, gives the unsaturated ether $CH_2=CH.O.C_2H_5$ (13 per cent) together with aldehyde, alcohol, and a gaseous mixture of ethylene, hydrogen, carbon monoxide, carbon dioxide, and methane.—**Albert Nodon**: The effects of ionisation by solar action.—**H. Colin** and **E. Guéguen**: The seasonal variations of the proportion of sugar in the Florideæ.—**H. Belval**: The transformations of the glucides in the banana: the formation of starch in the fruits.—**Mlle. Germaine Py**: The evolution of the cytoplasmic constituents during the formation of pollen grains and of the nutrient layer in *Senecio vulgaris*.—**F. Maignon** and **Ch. Grandclaude**: The hardening action of intravenous injections of glycerol. Sensitising effects of a single injection.—**L. Lutz**: The soluble ferments secreted by the Hymenomycetes fungi. Hydrolysis of the hemicelluloses.—**A. Paillot**: Bacterial parasitism and symbiosis in *Aphis mali*.

Official Publications Received.

BRITISH.

Proceedings of the Royal Irish Academy. Vol. 39, Section B, Nos. 14, 15: Azo Dyes derived from Diacetoresorcinol, by Dr. Joseph Algar and Mary Boylan; The Action of Grignard Reagents on Phthalide, by Dr. Joseph Algar and Albert V. Flaegel. Pp. 343-357. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

The Indian Forest Records. Silvicultural Series, Vol. 15, Part 2: A Glossary of Technical Terms for use in Indian Forestry. (Adopted for Official Use by the Silvicultural Conference, Dehra Dun, March 1929.) Pp. iii+50. (Calcutta: Government of India Central Publication Branch.) 6 annas; 8*d*.

The Himalayan Journal: Records of the Himalayan Club. Edited by Kenneth Mason. Vol. 2, April. Pp. vi+206+16 plates. (Calcutta: Thacker, Spink and Co.; London: W. Thacker and Co.) 5 rupees; 8*s*.

Union of South Africa: Department of Agriculture. Science Bulletin No. 85: Structure of the Cortex of Grass Roots in the more Arid Regions of South Africa. By Dr. M. Henrici. Pp. 12. 3*d*. Science Bulletin No. 87: The Bacterial Wilt Disease of Peanuts (*Arachis Hypogaea* L.). By A. P. D. McClean. Pp. 14+7 plates. (Pretoria: Government Printing Office.)

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1929. Pp. 16. (Pretoria: Government Printing Office.)

Rhodesia Museum, Bulawayo. Twenty-eighth Annual Report, 1929. Pp. 16. (Bulawayo.)

Department of Scientific and Industrial Research: Forest Products Research. Project 1: Progress Report 2. Tests of some Home-grown Timbers in their Green and Seasoned Conditions. By C. J. Chaplin and F. M. Mooney. Pp. iv+9. (London: H.M. Stationery Office.) 1*s*. net.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1248 (E. 32): Torsional Vibration of Crankshafts. A Description of the R.A.E. Mk. III Torsiograph. By the Staff of the Engine Experimental Department, Royal Aircraft Establishment. (I.C.E. 690.) Pp. 5+6 plates. 1*s*. net. No. 1252 (Ae. 402): Flow through Pipe Orifices at Low Reynolds Numbers. By F. C. Johansen. (T. 2797.) Pp. 24+14 plates. 1*s*. 3*d*. net. (London: H.M. Stationery Office.)

Stonyhurst College Observatory. Results of Geophysical and Solar Observations, 1929; with Report and Notes of the Director, Rev. E. D. O'Connor. Pp. xx+50. (Blackburn.)

University Grants Committee. Report including Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1928–29. Pp. 74. (London: H.M. Stationery Office.) 3*s*. 6*d*. net.

The Scottish Forestry Journal: being the Transactions of the Royal Scottish Arboricultural Society. Vol. 44, Part 1, March. Pp. xx+43+26+50. (Edinburgh.) 7*s*. 6*d*.

FOREIGN.

Report on Norwegian Fishery and Marine Investigations, Vol. 3, No. 10: The Propagation of our Common Fishes during the Cold Winter 1924; Investigations on the Norwegian Skagerrack Coast. By Alf Dannevig. Pp. 133. (Bergen: A.S. John Griegs Boktrykkeri.)

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin". Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 11, Livraison 3, Février. Pp. 301-371+plates 6-11. (Buitenzorg: Archipel Drukkerij.) 2.50 f.

U.S. Department of Commerce: Coast and Geodetic Survey. Serial No. 457: Magnetic Declination in Delaware, Maryland, Virginia, West Virginia, Kentucky and Tennessee. Pp. iii+112. (Washington, D.C.: Government Printing Office.) 20 cents.

Field Museum of Natural History. Anthropological Series, Vol. 19, No. 1: Melanesian Shell Money in Field Museum Collections. By Albert B. Lewis. (Publication 268.) Pp. 36+25 plates. Zoological Series, Vol. 17, No. 5: A Study of the Tooth-billed Red Tanager, *Piranga flava*. By John T. Zimmer. (Publication 269.) Pp. 167-219. Botanical Series, Vol. 7, No. 1: The Rubiaceae of Colombia. By Paul C. Standley. (Publication 270.) Pp. 175. (Chicago.)

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium. Vol. 24, Part 9: The Grasses of Central America. By A. S. Hitchcock. Pp. v+557-762+vii-xvi. (Washington, D.C.: Government Printing Office.) 35 cents.

Cornell University Agricultural Experiment Station, Ithaca, New York. Bulletin 490: Abandoned Farm Areas in New York. By Lawrence M. Vaughan. Pp. 285. Bulletin 491: Varietal Experiments with Soybeans in New York. By R. G. Wiggans. Pp. 19. Bulletin 493: Village Service Agencies, New York, 1925. By Bruce L. Melvin. Pp. 117. Bulletin 494: Some Facts concerning the Distribution of Fruits and Vegetables by Wholesalers and Jobbers in Large Terminal Markets. By M. P. Rasmussen. Pp. 115. Bulletin 495: Apple Varieties; Prices, Yields and Acreages. By G. P. Scoville and T. E. LaMont. Pp. 104. Bulletin 496: An Economic Study of Farm Electrification in New York; with a Discussion of Rural Electrification in the Provinces of Quebec and Ontario, Canada. By R. F. Buckman. Pp. 65. Bulletin 497: Pollination and other Factors affecting the Set of Fruit, with special reference to the Apple. By L. H. MacDaniels and A. J. Heinicke. Pp. 47. Bulletin 498: Protecting Orchard Crops from Diseases and Insects. By C. R. Crosby, W. D. Mills and W. E. Blauvelt. Pp. 80. Memoir 125: Inheritance and Linkage Relations of Virescent Seedlings in Maize. By I. F. Phipps. Pp. 63. Memoir 126: Effect of Storage in finely divided Feeds upon the Stability of the D Vitamin of Cod-Liver Oil. By L. C. Norris, G. F. Heuser and H. S. Wilgus. Pp. 15. (Ithaca, N.Y.)

Yale University. Report of the Director of Peabody Museum, 1928-1929. Pp. 24. (New Haven, Conn.)

Catalogues.

Catalogue of Botanical Works from the Library of a noted British Botanist, recently deceased, containing many Continental, British, Irish and Scotch Floras and serial Publications, also some Rare Herbals and Horticultural Works. (No. 12.) Pp. 16. (London: John H. Knowles.)

Elixir Valibrom B.D.H. and Elixir Valibrom Compound B.D.H. Pp. 4. (London: The British Drug Houses, Ltd.)

Scientific Books and Publications of Learned Societies. (Catalogue 348.) Pp. 74. (Cambridge: W. Heffer and Sons, Ltd.)

Diary of Societies.

FRIDAY, MAY 23.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 3 and 5.15.—*Discussion on Magnetism*:—Sir Alfred Ewing: Ferro-Magnetism and Hysteresis.—Dr. E. C. Stoner: Magnetism in the 20th Century.—Prof. H. S. Allen: Magnetism and the Quantum Theory.—Prof. C. G. Darwin: The Polarisation of the Electron.—W. Sucksmith: The Gyromagnetic Effect and Paramagnetism.—F. C. Powell: On the Change in Size of a Ferromagnetic at the Curie Point.—Prof. W. Peddie: Magnetisation and Temperature in Crystals.—Prof. W. Weiss and Dr. R. Ferrer: Sur l'aimentation à saturation des ferrocobalts et des nickel-cobalts et les moments atomiques des trois métaux.—Prof. W. Gerlach: Über neue Zusammenhänge von magnetischen u. elektrischen Erscheinungen.—Dr. P. Kapitza: Methods of Experimenting in Strong Magnetic Fields.—Dr. W. L. Webster: On Magnetostriction and Change of Resistance in Single Crystals of Iron and Nickel.—Dr. L. F. Bates: Observations on the Specific Heats of Ferromagnetic Substances.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Edinburgh and East of Scotland and Glasgow Sections of Society of Chemical Industry) (at Heriot-Watt College, Edinburgh), at 6.—Prof. J. Kendall: Chemistry in Naval Warfare.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section) (Annual General Meeting), at 8.—Dr. P. Stocks: Infectiousness and Immunity in Regard to Chickenpox, Whooping-Cough, Diphtheria, Scarlet Fever, and Measles.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—R. S. Whipple: Some Scientific Instrument Makers of the 18th Century.

SATURDAY, MAY 24.

LINNEAN SOCIETY OF LONDON, at 5.—Anniversary Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) (at Leamington Spa).

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Edinburgh and East of Scotland and Glasgow Sections of Society of Chemical Industry) (at Edinburgh) (continued from May 23).

MONDAY, MAY 26.

ROYAL SOCIETY, EDINBURGH, at 4.30.—Prof. Niels Bohr: Philosophical Aspects of Atomic Theory. (Address, and Presentation of the James Scott Prize.)

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—I. Cohen: The Jews under the Palestine Mandate.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—C. L. Woolley: Recent Excavations at Ur.

SOCIETY OF GLASS TECHNOLOGY (jointly with Deutsche Glastechnische Gesellschaft). (*May* 26 *to June* 3.)

TUESDAY, MAY 27.

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Annual General Meeting.

INSTITUTE OF PHYSICS (at Institution of Electrical Engineers), at 5.30.—Dr. W. H. Eccles: The Influence of Physical Research on the Development of Wireless (Presidential Address).

QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.—Pond Life Exhibition.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—W. P. Rowe: Art and Anthropology.

WEDNESDAY, MAY 28.

ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section), at 5.—Annual General Meeting.

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.

ROYAL SOCIETY OF ARTS, at 8.—H. Barnard: The Father of English Pottery—Josiah Wedgwood, F.R.S., Potter, Inventor, and Man of Science.

THURSDAY, MAY 29.

ROYAL SOCIETY, at 4.30.—Prof. R. Robinson: The Molecular Structure of Strychnine and Brucine (Bakerian Lecture).

FRIDAY, MAY 30.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5.—Annual General Meeting.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—H. R. Ricardo: The Development and Progress of Aircraft Engines.

ROYAL SANITARY INSTITUTE (in Public Halls, Blackburn), at 7.—Dr. J. J. Buchan and others: Discussion on The Re-organisation of Poor Law Hospitals under the Local Government Act.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—S. Hall: A Study of the Coastal Geology between Marazion and Porthleven, Cornwall (Lecture).—Dr. W. G. Shannon and L. G. Anniss: The Igneous Intrusions of the Stoke Fleming Area, South Devon.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir H. C. Harold Carpenter: The Metal Crystal.

SATURDAY, MAY 31.

ROYAL SANITARY INSTITUTE (in Public Halls, Blackburn), at 10.45 A.M.—Dr. V. T. Thierens and others: Discussion on The Need for Further Legal Powers with Respect to Ice-Cream.—H. W. Webb and others: Discussion on The Provision and Maintenance of Dustbins—Private or Municipal.

PUBLIC LECTURES.

MONDAY, MAY 26.

LONDON SCHOOL OF ECONOMICS, at 6.—Prof. C. Burt: The Measurement of Mental Capacities. (Succeeding Lectures on June 2 and 16.)

TUESDAY, MAY 27.

SIR JOHN CASS TECHNICAL INSTITUTE, at 7.—G. Patchin: Micro-Examination of Engineering Metals and Alloys (Armourers and Brasiers' Company Lectures). (Succeeding Lectures on June 3 and 10.)

WEDNESDAY, MAY 28.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.30.—Lt.-Col. G. E. F. Stammers: Lecture and Demonstration on Tropical Hygiene. (Succeeding Lectures and Demonstrations on May 29, 30, June 2, 3, 4, 5, and 6.)

THURSDAY, MAY 29.

CHELSEA PHYSIC GARDEN (Swan Walk, Chelsea), at 5.—Dr. A. W. Hill: Cabbages and Kings (Chadwick Lecture).

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, PADDINGTON, at 5.—Sir Thomas Lewis: Reactions of the Skin to Cold.

FRIDAY, MAY 30.

UNIVERSITY COLLEGE, at 5.30.—Prof. G. H. Parker: The Secretory Action of the Nervous System.

CONGRESSES.

MAY 26 TO 28.

CONGRESS OF LEGAL MEDICINE (at Paris).

MAY 28 TO JUNE 1.

GERMAN BUNSEN SOCIETY (Deutsches Bunsen-Gesellschaft) (at Heidelberg).—Principal Subject for Discussion: Spectroscopy and the Structure of Molecules.

MAY 28, 29, 30, and 31.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (at Portsmouth).

Wednesday, May 28, at 8 P.M. (at Municipal College).—O. G. S. Crawford: What is Archæology? (Presidential Address).

Thursday, May 29, at 11 A.M.—Alderman W. E. St. Lawrence Finny: The Crusades and Pilgrimages.

At 12 noon.—Prof. L. S. Palmer: Some Correlations between the pre-History of Hampshire and Africa.

At 11 A.M.—Lt.-Col. A. H. Wolley-Dod: The Experiences of a Field Botanist.

At 11.45 A.M.—Miss C. M. Gibson: Paper.

At 12.30.—Sir M. Abbot-Anderson: Resolution on the Preservation of Wild Flowers.

Friday, May 30, at 10 A.M.—H. Dewey: Cornish Geology and Scenery, with a Few Remarks on the Isle of Wight by Way of Comparison.

At 11 A.M.—Lt.-Col. J. H. Cooke; Origin of Scenery in the Portsmouth District, Geologically Considered.

At 12 noon.—Prof. L. S. Palmer: Recent Geology of the Portsmouth District.

At 10 A.M.—J. F. Marshall: The Organisation of Mosquito Control Work.

At 11 A.M.—Miss G. F. Selwood: Observations on Fauna Changes in a Bog at Bembridge, I.W.

At 8 P.M.—L. B. Benny: Progress in Astronomy.

Saturday, May 31, at 10 A.M.—G. E. Hutchings: Some Applications of Regional Survey in Education.

At 10.45 A.M.—A. Farquharson: A Regional Survey of Chichester.

At 11.30 A.M.—D. H. Thomson: Springs, Streams, and Wells in the Portsmouth District.