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Social Science Teaching.*

THE position of the teacher in any field of study becomes constantly more difficult and onerous as the years pass and as the accumulations of knowledge become greater and we hope richer, and as the proper scope and methods of further study and research become daily more intricate and urgent and harder to define or embody in graduate or postgraduate curricula. The accumulations of knowledge do indeed increase, but progress is often slow and tortuous and much has to be thrown into the discard under processes of selection more or less ruthless and impartial; for what is sound and apparently unquestionable knowledge to one generation may appear to the next as perfectly untenable. Nevertheless, the net result in most directions and during the past half-century is steady advance, especially and most remarkably in the physical sciences. In the social and moral sciences the acquisition of real and durable knowledge is more difficult to evaluate and sort out from a great mass of questionable matter, hazy hypotheses, and unfounded opinion; but here also there remains, after these necessary deductions, a solid residuum of accumulated fact and sound deduction. For the teacher in moral and social philosophy the main difficulties are to discover the solid ground in a country where treacherous swamps and shaking morasses abound, and to guide and stimulate his students to follow the right path and strike out new ones of their own; to strengthen and consolidate existing positions, and establish new ones.

The main burden or central core of Prof. Wallas's Huxley Memorial Lecture seems to have been precisely this: How to stimulate original constructive thought in social science studies, and in particular how best to enable the postgraduate student to make the right use of academic opportunities to enable him, if not to furnish immediately valuable contributions to knowledge, at least to find the right path to that ultimate end. But before arriving at this central theme Prof. Wallas traverses wide and varied territory and touches lightly on many matters of particular interest and importance. At the very outset, however, there may be some dissent from his view that the physical sciences have been the strong, and the moral and social sciences weak, and that this difference between the two branches was well exemplified in the events of 1914–18. Possibly this was not meant to imply that the physical sciences show their

* "Physical and Social Science." By Prof. Graham Wallas. (Imperial College of Science and Technology: Huxley Memorial Lecture, 1930.) Pp. 16. (London: Macmillan and Co., Ltd., 1930.) 1*s.* net.

strength predominantly in war and the moral sciences their weakness as a factor in the cause of peace; but on the face of it there seems to be a tendency here to uphold the ancient fallacy that science, especially physical science, has been ever more prone to offer its services to the gods of war than to the embassies of peace. Be this as it may, it is doubtless much more important, in considering the relations and differences between the physical sciences and the social or moral, to investigate thoroughly the remarkable way in which progress in physics and chemistry has profoundly altered those social and economic conditions which it is the purpose of social science to study.

This is the dominant fact of the present age: discovery and invention in physics and allied studies have proceeded at such a remarkable pace that the sociologist and statesman have probably been unable to make the necessary adjustments quickly enough, or have made false adjustments, and have been, generally, very much at sea as to the true fundamental tenets of their own somewhat tottering and unstable social sciences. This uncertainty or weakness, as also the strength of the physical realm, may best be shown in war or under the conditions which lead up to war, but this of course does not mean that the physicist is on the side of the militarist. In any comparison of the social and physical sciences the truest and happiest line to take is that which leads to the view that the dominant and fundamental facts in sociology are to a very large extent physical. It is becoming clearer every day that politics and economics are inseparable, that the former indeed is now mainly concerned with economics, that the older term, political economy, was much truer than the new one; and it is still more clear that the principal data in economics rest on a physical basis. The modern statesman therefore has to take a constantly wider view, more especially of the advances made in physical science and discovery.

Another point of comparison between the physical and the social or moral lies in the remarkable possibilities of introducing experimental methods into the study of the social sciences, an idea which occurred to Bentham and still more emphatically to Mill. Modern economic history is indeed one continuous programme of large-scale experiment, more or less consciously devised, of which Italy to-day is perhaps the most outstanding example, closely followed by many other countries. The conditions and results of these experiments, so far as ascertainable, are being closely studied, for example, by the International Labour Office at Geneva and by the principal universities and schools of economics throughout the world, and the student of the social sciences has, if he searches diligently and fervently, an abundance of material of absorbing interest on which to work and speculate and exercise all his powers of logical reasoning, of induction and deduction, and sufficient also to stimulate and develop all his imaginative and emotional powers, for purely intellectual exercise without these latter—if such cold and isolated working of the mind can in any way be conceived as possible—is quite useless. Prof. Wallas does well to stress this point, and surely when he did so he had the shades of the great Huxley and of the still greater Mill solemnly visible to his mind's eye if not actually visible aloft there in the dim recesses of the ancient lecture hall.

Emotion! To the trained intelligence allied with the sympathetic heart is there not enough, in the present condition of mankind in this his earthly environment, to stir the imagination and the feelings to their highest and deepest? Who of us can look abroad upon the world, upon its present social and economic and political structure and workings, without strange stirrings in our inmost being, without high hopes, deep anxieties, strong faith that right and good will ultimately prevail, and stern determination and indomitable will that they shall prevail. To the most distinguished professor of the highest rank, to the humblest of obscure research students, no work will appear unduly laborious, trifling, uncongenial, or vain when this great end is kept faithfully in view, the end described by Friedrich List as *Pour la patrie et l'humanité*, wherein nationalism brought to its highest and best is ultimately merged in internationalism and the commonwealth of nations.

In the teaching of the social sciences, then, as Prof. Wallas insists, it is necessary to realise fully the force of the emotional in scientific study and research, and we are accordingly faced with the old and universal desideratum in all teaching, an integrated development of all the faculties, both of thought and feeling, although of course thought and feeling, even if separated in name, cannot be separated in act and being. There are many difficulties in realising the ideal under modern conditions, especially for the postgraduate student engaged in more or less original research in the social sciences; and one of these difficulties arises from the scale of modern education and the almost complete impossibility of getting that close and personal contact between professor and student which was so helpful in an older and smaller and

less strenuous academic world. Prof. Wallas appears to suggest that doctorates should be made somewhat more difficult and involve at least a longer course of study, but the mere lengthening of the course of study by one or more years would not in itself be necessarily desirable or productive of the looked-for result. In the course of his lecture he introduces, very unobtrusively and lightly, a suggestion that the student should try, at least from time to time, "to turn the flaccid pages of his notebook into something that a newspaper critic might regard as decent literature". Here indeed is a practical suggestion that might bear fruit: scientific literature generally, from a purely literary point of view, has not maintained that splendid standard set up by Mill, Adam Smith, Huxley, and other giants of a former age. The student of social science to-day may doubtless find it very difficult to approach that standard, but, equally doubtless, he will find it wonderfully helpful and interesting to try; and he too, more than many, has themes enough—absorbing, thrilling, passionate—to stir him to the attempt.

W. G. L. C.

Embryology and Recapitulation.

Embryology and Evolution. By G. R. de Beer. Pp. viii + 116. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 5*s*. net.

THIS little book is from the pen of Mr. de Beer, who is one of the more brilliant of the younger Oxford men. Its aim is to "dethrone the theory of recapitulation", to persuade us that the development of the individual throws no light on the past history of the race, and that therefore Ascidians need not necessarily be descended from a free-swimming vertebrate even though they begin their lives as tadpoles.

It is, we believe, the custom amongst brilliant Oxford men to fight for 'lost causes', and surely no cause was ever more hopelessly lost than this; for the doctrine of recapitulation is one of the most securely based inductions of zoology and every year brings additional confirmations of it to light.

It is interesting, therefore, to see how Mr. de Beer sets about his task. Since the history of the race can only be deduced from a study of comparative anatomy, palæontology, or embryology, Mr. de Beer must have independent knowledge of what this history was before he can say that embryology does *not* give a true account of it. But palæontology is only available in a few cases in which the lineage series is fairly complete, and from the study of these cases it has come about that palæontologists are amongst the strongest supporters of the doctrine of recapitulation. Comparative anatomy, so far as it can be legitimately used to give correct information as to phylogeny, is also a strong support of the theory—for comparative anatomy can only take us back a very short way. If we strive to penetrate the veil of the past by the comparative anatomy of living adult forms, we soon arrive at a stage where all is wild speculation and fancy. But where the type of structure is constant in a well-defined group and an abnormal genus occurs within this group, the young stages of that genus have the typical structure of the group, and this is the solid foundation of the recapitulation theory.

Mr. de Beer's method is to select some embryo or larva and then to point out that it is difficult to imagine that it could have exactly resembled an ancestor. But no one, least of all Haeckel himself, who put forward the theory of recapitulation, ever contended that the ancestral record had suffered no secondary modifications. Most of Mr. de Beer's cases are old and well-known ones with which we have fully dealt in our "Textbook of Invertebrate Embryology"; in this book the reader will find the causes and nature of these secondary changes fully discussed and we shall not waste the time of readers of NATURE in further elucidating them here. But Mr. de Beer's reading has been singularly defective: for example, he credits Garstang with having been the first to direct attention to the affinity between the echinoderm larva and the larval stages of vertebrates. The facts are that the tornaria larva of *Balanoglossus* was mistaken for an echinoderm larva when it was first discovered, and when Bateson, from embryological data, showed the vertebrate affinities of *Balanoglossus*, the connexion between echinoderm and vertebrate phyla was suspected at a period when Prof. Garstang was still at school. A solid basis for the theory was only afforded when the embryology of *Asterina gibbosa* was worked out in 1896.

Mr. de Beer lays great stress on a few cases where the palæontological record seems to contradict the evidence of embryology. One of these is the structure of the ammonites, for these extinct molluscs carried their life-history around with them written on the inner coils of the shell. In some cases these inner coils are ribbed and the outer coils plain, but in the majority of cases the inner coils are plain and the outer ribbed. It is argued that, whether evolution proceeded from ribbed to plain or vice versa, one of these records must be wrong. But the strong probability is that

both of them are correct. For the ribs on an ammonite's shell are not mere ornament. They are hollow corrugations which give strength to a shell otherwise too thin to afford adequate support. Now thinness or thickness of shell is dependent on the abundance of the supply of calcareous matter: if a thin-shelled form wandered into a region where there was plenty of lime its shell would be thickened, and the corrugations would become functionless and disappear, whilst a species with a plain shell would find it necessary to introduce corrugations, if the supply of lime became deficient.

A great test of the soundness of a theory is whether or not it can predict results the truth of which will afterwards be independently confirmed. Two examples of this may be briefly alluded to here. The tympanic bone in mammals was considered on the evidence of the comparative anatomy of recent species to be the equivalent of the quadrate of reptiles, which is frequently curved round the auditory opening. The embryological evidence suggested that the quadrate of reptiles had been changed into the incus bone of the mammalian ear. Now from Africa a series of skulls have been discovered showing every stage in the transition from quadrate to incus. Again, the palæontological evidence makes it clear that the five-fingered hand of the land vertebrate must have been derived from the fin of the Devonian crossopterygian fish. Steiner, working on the embryology of the wing of the bird, arrived at the conclusion that the fourth finger represented the axis of the fin and that three rays on the preaxial side corresponded to the thumb and first two fingers, whilst the little finger represented a single postaxial ray. The same conclusion was independently arrived at by palæontologists studying the fins of the latest crossopterygian fish and the hands of the earliest land animals.

Mr. de Beer commits an amusing error when he says that the symmetrical stage in the development of the hermit crab does not represent its adult ancestor but the *larva* of the crab from which it is derived. There is no close affinity between so-called 'hermit' crabs and true crabs, and the former are related to the Galatheidæ, which when adult have well-developed symmetrical abdomens like those of the young hermit crab.

It might be asked what motive induced Mr. de Beer to embark on this errand of hopeless knight-errantry. We are not left in doubt as to the cause. It is an attempt to support the gene-mutation theory of evolution, which is totally irreconcilable with the recapitulation theory, a fact which Morgan himself has recognised. Now supporters of the recapitulation theory freely admit that mutations constitute an important set of biological phenomena: they know that when mutations are crossed with the type segregation occurs, and it is clear that the study of these abnormalities is of great importance to all interested in cultivated plants and domestic animals. They doubt very much if any additional light is thrown on the nature of mutations by inventing imaginary causes called genes to account for them: but they are perfectly certain that genes are not units out of which the hereditary powers of an animal are built up: that, on the contrary, genes represent the effects of external damage to these powers, as the experiments of Miller have clearly proved, and that therefore genes have played no part in evolution. A prominent geneticist said, in discussing the results of Miller's experiments, "The mutation theory of evolution is dead".

Mr. de Beer's original contribution to the discussion of embryology is to employ the terms 'pædomorphosis' and 'gerontomorphosis' for two supposed types of evolution. By the latter, he means changes occurring relatively late in life-history which result in an improvement in an existing organ: by the former, changes suddenly occurring in the earlier stages by which the whole trend of evolutionary history is altered and a new phylum springs into being.

We shall briefly sketch the origin of the Gastropoda according to the recapitulatory theory and to pædomorphosis and appeal to readers of NATURE to decide between them. According to the first theory the original mollusc was a bilaterally symmetrical animal which glided over the mud by means of its ventral cilia and was able to keep its body on an even keel. But when it took to crawling over hard ground its humped back, which was protected by the shell, gradually sagged to one side and this caused one side to be stretched and the other to be crushed: the stretched side grew more quickly than the crushed side, and thus was initiated that inequality of growth which not only gave rise to the spiral shell of the gastropod but also twisted the anus round to the front of the neck. This change, which must have taken ages to produce, was already complete in the Cambrian 400,000,000 years ago—it was a change in adult habits and structure, but it is now pushed back by tachygenesis until it occurs during the free-swimming stage of the larva.

According to pædomorphosis, the gastropod owes its origin to the occurrence of a sudden and miraculous 'mutation' in the larva by which at one fell swoop it twisted its visceral hump and shell through

an angle of 180 degrees. By this fortunate miracle it now became able to protect its ciliated band or velum by withdrawing it within the shell, which it previously was unable to do, and so it survived whilst all its neighbours perished. (Incidentally we may remark that the Lamellibranch veliger, which has its anus and mantle-cavity behind, is nevertheless able to withdraw the velum within the shell.)

The mutation theory of evolution—or evolution by sudden jumps—was first put forward by Bateson in 1894. When Haeckel attended the International Congress of Zoology held at Cambridge in 1898 this theory was discussed, and Haeckel's pregnant criticism was, "If this sort of theory is to be put forward for acceptance it would be better to return to Moses at once". E. W. MACBRIDE.

Universities of the British Empire.

The Yearbook of the Universities of the Empire, 1930. Edited by Sir H. Frank Heath. Published for the Universities Bureau of the British Empire. Pp. xv + 840. (London: G. Bell and Sons, Ltd., 1930.) 15*s*. net.

THIS super-calendar of the seventy universities of the British Empire is packed with every kind of information about them likely to interest the learned world, government departments, clubs, and the public generally. Who's where in those universities is here ascertainable with a minimum of trouble: likewise who's who so far as concerns appointments and degrees held by professors and other university teachers and the university by which each degree was granted. The personnel of each university is exhibited in such a way as to show at a glance the strength of the staff employed in each field of learning. Following this directory is a summary account of the equipment of libraries, museums, laboratories, etc., of the university, the degrees, diplomas, and certificates which it confers, its composition fees, scholarships open to graduates, residential accommodation, extra-mural work, publications, and, finally, a summary of events of outstanding interest which occurred during the past academic year, with statistics of the numbers of students in attendance and degrees conferred. Brief notes concerning the university's origin, the salient facts of its history and its constitution, are prefixed to this summary in many cases, but in others particulars of the university's early history, which appeared in last year's issue, have been replaced by a note—"For early history *see* the Yearbook for 1929". In chapters introductory to the sections dealing with the universities of Great Britain and Ireland, of Canada, of Australia, of South Africa, and of India, respectively, their common history, regulations, and practice are summarised.

Appended to these sections are accounts of the conditions governing admission to various professions and careers for which university studies are a fitting preparation, matriculation examinations and admission of students from abroad into the universities in the British Isles, lists of post-graduate scholarships, etc., and lists of centres of scientific research and of scientific information, whether connected with universities or not, to which independent research workers are admitted.

A noteworthy feature of the present issue is the skilful marshalling of the information collected concerning the facilities available in the British Empire for scientific research in all its principal branches, and the aids available in every country for post-graduate students and research workers of British citizenship irrespective of the place of their education: those open only to graduates of particular universities being particularised in the appropriate sections of the main part of the book. Such a comprehensive survey, which Sir Frank Heath, with his experience of work in the Department of Scientific and Industrial Research, was peculiarly well fitted to undertake, has not hitherto been published and was overdue.

The "Yearbook" lacks tables of comparative statistics. So far as Great Britain is concerned, the inclusion of such tables would, it is true, have involved a duplication, though not necessarily a wasteful duplication, of a service already undertaken by the University Grants Committee. As regards the other parts of the Empire, the absence of comparative statistics is to some extent justified by considerations set forth on page 6 of the introductory chapter on the universities of Great Britain and Ireland, wherein an estimate of the number of full-time students (48,600) is qualified by the remark that the figures do not include the students of the institutions other than universities and university colleges in which professional education of university grade is given in theology, teaching, agriculture, etc.; nor students reading privately for the external degrees of the University of London (this makes the more noticeable the absence of statistics of those degrees), for the bar, etc.: "This makes comparison with statistics of other countries difficult, as does also the fact that the work of the higher forms of many of our secondary and 'public' schools corresponds with the earlier stages of the work done in colleges and

collegiate departments of some foreign universities, *e.g.* in America". Despite these drawbacks, the following table, summing up certain of the statistics given in the "Yearbook", is not without interest. The figures for the French-Canadian universities appear to include a large proportion of students engaged in work of pre-matriculation standard, and their degrees (baccalauréat) do not correspond to any of the English degrees.

	Full-time* Students.	First Degrees.
Canada:		
Toronto	6,422	839
McGill	3,191	343
4 western provincial universities	6,804	766
3 French universities	9,774	407
12 other universities	6,457	795
Canada, totals	32,648	3,150
Australian universities (6)	6,390	1,031
New Zealand	1,868	400
South African universities (4)	5,830	902
Indian universities (17)	..	13,248

819 American universities and colleges, excluding pre-matriculation departments, and 155,603 law, medical, dental, theological, pharmacy, and engineering students } Enrolled students in 1925–26, both full-time and other: 611,660

Close co-operation between the parts of the British Empire is an ideal which innumerable public speakers and writers constantly proclaim. What more promising field for such co-operation could be found than the learned world, and what more indispensable documentary aid to co-operation in this field than the "Universities' Yearbook"? Yet we are told in the preface that the sales are so comparatively small that the annual deficit incurred in respect of it has been very heavy and the Universities Bureau has, in consequence, been constrained to raise its price from 7*s.* 6*d.* to 15*s.* The new price cannot be called excessive when compared, for example, with the price of "Minerva", but one regrets that the increase should have been necessitated by the inadequacy of the Bureau's income.

* The number of *part-time* students is not given in all cases. In universities in Canada, Australia, New Zealand, and South Africa, for which their number is given, there were 11,359, as compared with 29,791 full-time.

A Logical Course of Elementary Physics.

Physics. By W. J. R. Calvert. (General Science Series.) Part 2: *Sound.* Pp. vii+142. 3*s.* Part 3: *Light.* Pp. vii+202. 3*s.* Part 4: *Magnetism and Electricity.* Pp. x+333. 4*s.* (London: John Murray, 1929.)

THESE three books are worthy successors of the author's mechanics and heat—the first of the series—which was published in 1924. Mr. Calvert is well known as a teacher of teachers, and no one who instructs the young in the elements of physics can afford to ignore these volumes, whatever conclusion he may reach as to the desirability for their use by his pupils.

Obviously the outcome of long and thoughtful experience, the books are, in a sense, too good, for they read almost as if they were taken down by a stenographer as the lectures were delivered, and it is to be doubted if text-books should read like the spoken word. The movement is sometimes too slow, too logical, and perhaps too laboured. Yet this is not always so, for on the twentieth page of the volume on light we find, "Our present views have returned somewhat to the Newtonian view, except that, in the place of corpuscles, we have quanta of energy, associated with the idea of a periodic electro-magnetic disturbance". Thereafter that volume trips more lightly, and the going is made easier by the relegation of lens formulæ and details about practical work to appendices at the end of the book.

The design of the author has been to give a physical basis to the subject, and his treatment throughout the series has been as devoid of mathematics as is reasonably possible. In this he has been very successful in the volume on sound, which, being full of interesting practical applications, holds the attention of the reader. The chapters on reflection here are very good.

In some respects, the book on magnetism and electricity is the most interesting of all. Many, perhaps most, teachers prefer to start from some point within the pupils' ken: batteries, ammeters, electric bells, and the like. Not so the author, who only allows his readers to reach these things after a logical and lengthy journey. Whether they will have acquired a thirst for more knowledge by that time may be doubted, but there is no doubt at all about the skill with which the route has been mapped out. Those who insist on the logical development of ideas for the young will find it to perfection here. Starting with only just sufficient magnetism for his purpose, the author deals immediately with current measurement, and then by an easy transition passes to electrostatics, where he wisely avoids the usual system of units. Then follows—too soon, as some will think—a chapter on the structure of the atom, after which potential measurement is introduced by the heating effect of current, when at length the way to Ohm's law is opened up, and all is plain sailing again.

If the author has chosen a hard route, he has at least made it as easy as possible by avoiding un-

necessary difficulties, as for example the measurement of magnetic moments and the use of the tangent galvanometer, which can be found by the morbidly curious in appendices at the end of the volume. An excellent chapter on rays adds to the interest of the book, and there is an admirable preface, which provides food for the teacher, if not for the taught.

Miers' Mineralogy.

Mineralogy: an Introduction to the Scientific Study of Minerals. By Sir Henry A. Miers. Second edition, revised by Dr. H. L. Bowman. Pp. xx + 658. (London: Macmillan and Co., Ltd., 1929.) 30*s*. net.

THE first edition of this book appeared in 1902. It was clearly written, admirably illustrated by drawings and photographs, and it soon became a standard text-book on the subject of pure mineralogy. The editor of the second edition, who is also Sir Henry Miers's successor in the chair of mineralogy in Oxford, has added to the illustrations, brought the text up-to-date where necessary, adding a new chapter on the investigation of crystal structure by means of X-rays, but has retained the original text so far as possible.

In the main, this plan has been successfully carried out, and it is perhaps only in the 'Introduction' that there has been a too strict adherence to the original. In the body of the text full justice is done to the recent advances in the study of crystal structure, but in the 'Introduction' it is barely mentioned, with the result that some passages, which in the first edition were remarkable forecasts of possible developments, are now almost out-of-date, so nearly have their prophecies been fulfilled.

The additions to the text, including 63 new figures, amount to 74 pages, of which 22 are devoted to the new chapter on crystal structure, and further pages in the descriptive part of the book give explanations of the structure of diamond and graphite, blende and wurtzite, α- and β-quartz.

It is not to be supposed that the relatively small additions to the text indicate either lack of progress in mineralogy or want of thoroughness on the part of the editor. Much that has been done for the advancement of mineralogy within the last twenty-eight years lies outside the scope of the book, which was clearly limited by the author to the 'essential' properties of minerals and the means by which they are investigated. In the description of the 'essential' properties of minerals, apart from the determinations of crystal structure, there is little new matter which can find a place in a text-book. The generally accepted system of classification has remained unaltered and work on systematic mineralogy has been devoted to the perfection of measurements and chemical analyses, and to the description of new minerals most of which are too rare to be included in a book intended for students. In the improvement of methods by which the properties of minerals are investigated there is much that is new that might have been introduced had space permitted. There are, however, many good text-books to which students can be referred for recent developments in petrographic methods, in the use of the 'universal' stage of Fedorov, and in the study of polished plates of opaque ores, and by deciding to omit descriptions of these methods the editor has left us with a text-book which is not only reasonable in size but also eminently readable.

The printing of text and figures has been admirably done, and the price is not excessive for a book of this size.

Our Bookshelf.

Ions, Electrons and Ionizing Radiations. By Prof. James Arnold Crowther. Fifth edition. Pp. xii + 353. (London: Edward Arnold and Co., 1929.) 12*s*. 6*d*. net.

THE appearance of a fifth edition of Prof. J. A. Crowther's well-known book, which gives in a simple form a comprehensive and systematic treatment of an important range of experimental physics and its interpretation, has been necessitated by the progress of research during the past five years. The author's object has been to preserve the point of view of the book in relation to scientific thought, and the alterations effected are of a minor character; among the most important additional sections are those dealing with Aston's work on the packing effect, the Compton effect and theory of X-ray scattering, the work of Davisson and Germer and of Thomson on the diffraction of electrons by a crystal, Millikan's discovery of cosmic radiation, and the magneton together with the experiments of Gerlach and Stern. New and improved photographs by Wilson of the tracks of ionising radiations replace the earlier ones. The alterations have resulted in an enlargement of the book to the extent of about 24 pages.

As pointed out by the author, the task of selection from new and old material has not been easy. In a work of this type the quantum theory must necessarily play a prominent part in an interpretation of the experimental basis of physics; the section on the quantum theory is, however, unchanged, and a reader otherwise unaware of the present position would scarcely suspect the epoch-making changes through which this matter has been passing. A few lines only are devoted to the

new wave theory of the electron in connexion with the work on electron diffraction mentioned above. Sections dealing with the magneton and the electron theory of conduction include no mention of the spinning electron and Sommerfeld's work on the theory of conduction with the help of the Fermi-Dirac statistics.

Though the author has deemed it advisable to refrain from introducing matter which is at present somewhat speculative, the more advanced reader will be pardoned a feeling of regret that the results of some of the immense ranges of recent research have not found a place in the new edition.

N. M. BLIGH.

Artists in String: String Figures, their Regional Distribution and Social Significance. By Kathleen Haddon (Mrs. O. H. T. Rishbeth). Pp. x + 174. (London: Methuen and Co., Ltd., 1930.) 6*s*. net.

MRS. RISHBETH has long been known as a zealous collector and student of the string games known popularly as 'cat's cradle'. In this volume she justifies a study which, to the Philistine, may seem puerile, by indicating its bearing upon the problems of cultural anthropology, showing on one side that these string games, especially in their more complicated forms, represent an expression of a creative or artistic impulse, and, on the other, give the student certain quite specific pieces of information about the environment and social facts in the life of the people among whom they are found. The games are here described according to their geographical distribution, five games being taken from each group.

Although more than eight hundred games are known, there are many and striking gaps in our knowledge. Yet when due allowance is made for this, the first remarkable fact to emerge is the peculiar geographical distribution of the games. While the string figure is widely distributed, occurring in North America, probably South America, though the Guianas at present furnish the only record, Africa (at present sparsely), Australia and Oceania, yet Eurasia is practically a blank space. The author, therefore, concludes that while the Eskimo, redskins, tropical browns and blacks, have these figures, the white, yellow, and Asiatic brown people have practically none.

The subjects also are curiously distributed, or perhaps more correctly show curious absences. In West Africa, for example, no figures represent big game. Mrs. Rishbeth suggests that these absences may conceal interesting evidence as to native ways of thought, and in any case call for further investigation. Mrs. Rishbeth's suggestive treatment of her fascinating subject cannot fail to stimulate further collection which may bring the information desired.

An Inorganic Chemistry. By Prof. H. G. Denham. Second edition. Pp. viii + 688. (London: Edward Arnold and Co., 1930.) 12*s*. 6*d*. net.

PROF. DENHAM gives a lucid and logical exposition of his subject within a moderate compass. He bases his arrangement upon the periodic system, and introduces new laws or generalisations as the occasions arise. In this way he secures a continuity of narrative which is sometimes lacking in works dealing with this subject. His method of presentation has the further merit of effecting a smooth correlation of the purely descriptive side of inorganic chemistry with some of the leading conceptions of physical chemistry. Objection may be raised to certain details, such as the designation of phenol as an aromatic alcohol (p. 377) and the statement (p. 363) that "nearly three hundred hydrocarbons have been isolated". On the whole, however, the book appears to contain very few factual misstatements. We suggest that more information respecting the localities in which important minerals are found might be included with advantage in a future edition. Altogether, this is a carefully planned book, which may be recommended for the use of advanced classes in the schools and intermediate classes in the universities. It is well printed, adequately illustrated, and easy to read.

Growing Up: How one did it in Different Times and Places. By Ellen C. Oakden and Mary Sturt. Pp. 238. (London: Kegan Paul and Co., Ltd., 1930.) 5*s*. net.

THIS book embodies an excellent idea, and the idea is very competently carried out. It is meant for boys and girls, but we should not envy the adult who failed to find it interesting. The book tells what sort of lives boys and girls lived, and especially how they were educated, in other times and in other lands—in ancient Greece, in the Middle Ages, and the age of chivalry, in Shakespeare's time, a century ago, and fifty years ago. It tells how ladies were made in times gone by, and what sort of life a boy lived in the pioneer days of western America. The fare is varied, but not incongruously so.

One point strikes us forcibly. Our forbears never learnt the elements of scientific method in school laboratories. But some of them, as this book reminds us, managed to acquire a keen and a life-long interest in the wonders of earth and sea and sky. The old-fashioned naturalist, who loved Nature, but set small store by analysing and dissecting her, knew something of the joy of living, which is less common since we began to teach science in our schools. So perhaps even now we have not hit upon the very best way of 'growing up'.

The Living Past. By John C. Merriam. Pp. xii + 144 + 16 plates. (New York and London: Charles Scribner's Sons, 1930.) 7*s*. 6*d*. net.

THE author of this little book has obviously pondered deeply on the facts revealed by geological science. He tells us that the seven chapters are "episodes selected because of their touch with especially significant aspects of the problem of life history", and the subjects he has chosen are mainly drawn from the magnificent sections of the Grand Canyon of the Colorado. On his themes the author has written lightly with singular grace and charm, and the absence of technical details will add to the pleasure of the general reader. The book is well illustrated; but the price seems too high.

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 of any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Crystal Structure of Krypton.

WE have made two Debye-Scherrer exposures of solid krypton at the temperature of liquid hydrogen boiling under normal pressure, one with copper $K\alpha$ radiation, the other one with unfiltered iron radiation. As was to be expected, we found a face-centred cubic lattice. The lattice constant is 5·59 A. The calculated density is 3·13. The distance of the centres of neighbouring krypton atoms amounts to 3·96 A., whereas from viscosity measurements the value 3·23 A. is deduced for the diameter of the atoms. Ratio 1·22 ; the analogous ratios for neon, argon, and xenon are 1·35, 1·29, and 1·23 respectively.

We are indebted to G. Claude for the quantity of krypton we used.

A more detailed account of this work is being published in the *Proceedings of the Amsterdam Academy*.

W. H. KEESOM.
H. H. MOOY.

Leyden, May 31.

IN a previous letter to NATURE upon the crystal structure of xenon, we announced that we would next examine krypton. We have modified the camera used for the previous experiments by reducing to a great extent its internal volume and making it perfectly gas-tight, so as to be able to work in a krypton atmosphere, thus overcoming the difficulties previously encountered.

The gas has been brought to the solid state upon a quartz capillary (set in the axis of the Debye camera) internally cooled by liquid nitrogen. The photograms obtained, with iron anticathode, showed 14 lines, 4 of which belong to the $K\beta$ radiation, corresponding to a face-centred cubic structure. The lattice constant of the elementary cell of krypton, containing 4 atoms, is $a = 5{\cdot}78$ A. The following data have also been calculated : volume, 193×10^{-24} c.c. ; density, 2·83 gm./c.c. ; atomic radius, 2·04 A. Experimental details and a discussion upon the present data will be published elsewhere.

G. NATTA.
A. G. NASINI.

Departments of General and Industrial Chemistry,
Royal Polytechnic, Milan,
May 31.

Ethyl Alcohol : a Product of High Pressure Syntheses.

DURING a recent discussion at the Royal Society on catalytic reactions at high pressures, Mr. M. P. Applebey of the Imperial Chemical Industries, Limited, Billingham, remarked that " in our experience we have never succeeded in obtaining with any catalyst whatsoever, more than a mere trace of ethyl alcohol ".

This statement, which expresses a matter of fact, has since been followed by allusions in the Press which appear to suggest that there is some fundamental reason why this alcohol, unlike other primary alcohols, may not be produced in the series of condensations occurring between carbon monoxide and hydrogen in presence of various catalysts.

Dr. E. K. Rideal, writing in NATURE of April 12, p. 584, refers to the production through the foregoing condensations of a whole sequence of higher aldehydes and alcohols, " with the possible exception of ethyl alcohol ".

A paraphrase of this statement appears in a leading article of *Chemistry and Industry*, April 25, 1930.

On the other hand, there is the testimony of Franz Fischer and Hans Tropsch (" Brennstoff Chemie ", **4**, 281 ; 1923), who found that in the presence of alkalised iron under pressure, ethyl alcohol was present among the condensation products of carbon monoxide and hydrogen. Moreover, in a lecture to the German Chemical Society (*Ber.*, **59**, 30 ; 1926), A. Mittasch included ethyl alcohol in a comprehensive list of the organic products of this condensation. It should, however, be recognised that these German memoirs indicate conditions such as favour the production of very complex mixtures, including alcohols, ketones, aldehydes, organic acids, esters, and hydrocarbons.

Working with various catalysts we have obtained evidence of the formation of ethyl alcohol in not inconsiderable quantities. Our specimens of alcohol boil at 78·2°/760 mm. and furnish ethyl 3 : 5-dinitrobenzoate melting at 92° and giving the same melting point when mixed with a 3 : 5-dinitrobenzoate prepared from an authentic specimen of ethyl alcohol.

It would accordingly be desirable to suspend judgment on this debated point until the appearance of more complete evidence. We propose to publish in the near future a detailed account of our production of ethyl alcohol from carbon monoxide and hydrogen.

G. T. MORGAN.
R. TAYLOR.

Chemical Research Laboratory,
Teddington, Middlesex,
May 24.

The Acquired Characters of *Alytes*.

I AM glad that Prof. MacBride (NATURE, May 3) agrees that a reversion to the original environment would be likely to produce the result I suggest, but I am sorry he assumes that I accept Kammerer's work in the sense he does. What I said was, that even if all Kammerer's results with regard to *Alytes* were accepted, the experiment could not be held as complete until the effects of a reversion to the original environment had been demonstrated. Prof. MacBride now says that, unless there existed in the germ-plasm potentialities to respond in a definite manner to changes in the environment, there would be no possibility of evolution.

I entirely fail to see any reason for this assertion. Such potentialities are doubtless of great value to the individual, but what is their relation to evolution ? That such potentialities have been produced and may be modified in the course of evolution like other characters, most biologists would, I imagine, be prepared to admit ; but it seems reasonable to regard them as the product rather than as the cause. Let me state a hypothetical case. An animal during its development passes through a stage where it possesses gills. It has the potentiality to respond to the environment so that if the parents are kept from water the gill stage occurs in the egg, but if the parents are given free access to water, the animal hatches out earlier and the gill stage occurs in the free-swimming individual. I do not see, however often the change of environment may be made during consecutive generations, with its consequent temporary change in the character, that any new character or permanent

change in an existing character need be assumed. For such a permanent change, a modification in the potentialities must occur.

Prof. MacBride apparently believes that such a modification is produced by the action of the environment upon the potentialities. This explains his assertion that evolution would be impossible without potentialities in the germ-plasm to respond in a definite manner to the action of the environment. He is assuming the truth of *his* view of a disputed point. The opposite view is that such modifications are produced in successive generations by the survival of those variations which occur in animals on the production of a new individual. The case of Kammerer's *Alytes* does not seem to me to be convincing, even as stated by Prof. MacBride.

Since writing the above, I have seen Prof. Przibram's letter in NATURE of June 7, p. 856.

Even if the statement be accepted that *Alytes* continues to lay its eggs in water after the temperature has been reduced, the original environment has not been restored; if it had, there would not be sufficient water for it to lay its eggs in. A true 'return' to former conditions, then, necessitates the absence of water. In saying that deprivation of water would not be such a 'return' but "induction in the opposite direction", Prof. Przibram appears to me to be making an assumption necessary only if the facts are to be forced to fit in with a preconceived idea. He has for the moment forgotten that von Nägeli's experiments have been carried a step further in the United States, and that the plants show various stages of modification in the characters they develop, corresponding to the variations in the environment. Given the same modification of environment, the same modification of character appears, whether extreme or intermediate. I see no more suggestion of the inheritance of acquirements in the case of *Alytes* than in the case of the plants.

If Prof. Przibram will extend his admission that the development of the nuptial pad depends upon 'external conditions' to the laying and hatching out of the eggs of *Alytes*, I cannot see why he should quarrel with any statement in my letter of April 12. As I said then, Kammerer's experiments with *Alytes* are not complete as they stand.

CHARLES WALKER.

The University,
Liverpool.

An Exceptional Whirlwind in Natal.

AT the village of Impendhle, Natal, on Mar. 23, 1930, there occurred a whirlwind of considerable violence, and the damage resulting therefrom illustrates in a remarkable manner the great intensity of the rotatory and suctional forces that can be engendered. The course travelled by the whirlwind could be followed, as a cloud was caught up in its vortex (Fig. 1).

I am indebted to Mr. E. T. A. Minkner for the following notes and for the accompanying photographs.

On the morning in question the wind came from the north, and during the whirlwind it changed to the west. There was a little hail, but not much rain. A peculiar, horizontal cloud was first noticed to the west of the village near the Impendhle Mountain. The cloud moved in a northerly direction, and when above a certain hill known as the 'W' it became funnel-shaped. The funnel travelled in a circular course to the north and round to the east of the village. Afterwards it became longer and thinner until it disappeared in the general canopy of cloud. The photograph was taken at 1.45 P.M., when the funnel-shaped cloud was almost in contact with the ground.

The line of travel of the apex of the whirlwind over

FIG. 1.—Cloud caught up by whirlwind, Impendhle, Natal, 1.45 P.M., Mar. 23. (Photograph by Mr. E. T. A. Minkner.)

the ground was marked by devastation. The rotatory force rooted up grass and played havoc with a group

FIG. 2.—Trunk of wattle tree twisted and shattered by whirlwind of Mar. 23 at Impendhle, Natal. (Photograph by Mr. E. T. A. Minkner.)

of black wattle trees. One tree about $3\frac{1}{2}$ feet in circumference was bodily twisted off its roots and drawn up about 90 feet in the air, while another

larger tree had its solid trunk split and twisted in the manner shown in the second photograph (Fig. 2).

The top of the tree and most of the lateral branches were broken off, and doubtless the leverage exercised by the action of the rotating wind on the boughs assisted materially in the twisting and shattering of the trunk, since it is almost inconceivable that the force exerted would be so excessive as to twist a tree trunk by direct action on the trunk itself.

The great suctional force was demonstrated by the tree which was drawn up into the air. It is clear that, if the whirlwind had happened to pass over a body of water containing fishes, a rain of fishes would have resulted. In this connexion it may be mentioned that on April 14, 1909, an authentic case of the fall of fresh-water fishes occurred at Newcastle, Natal.

ERNEST WARREN.

Natal Museum,
Pietermaritzburg.

The Oogenesis of *Lumbricus*.

THE current number of the *Quarterly Journal of Microscopical Science* contains an interesting paper by Dr. Vishwa Nath on the vexed question of the oogenesis of the earthworm (*Pheretima*, in his case).

After having gone over the earthworm oogenesis again, we agree with practically everything Dr. Nath has written. However, we have found a 'vacuolar system' as well. Dr. Nath states that "Vital dyes, namely, neutral red and janus green *B*, have been extensively used [by him] in the form of very thin watery solutions, but they do not in any way improve the appearance of the egg. . . ." Dr. Nath, Mr. Harvey, and the senior writer have previously overlooked the 'vacuolar system', but if the ovary is left for *about an hour* in neutral red Ringer (pink solution) a fine system of red globules stains up. We have no doubt that if Dr. Nath tries longer periods he will also find these globules.

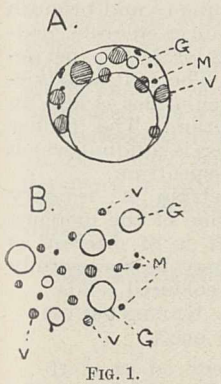

FIG. 1.

Now there can be no doubt that there is a real vacuolar system in mammals, molluscs, and insects, for in certain cases it can be seen without staining, or in directly fixed tissues (Kolatschew). But these globules in the germ cells of earthworms take a much longer time to stain (or appear). In cœlomic epithelial cells (Fig. 1, A), however, they appear quickly, and certainly resemble the 'vacuome' of molluscs. We could not satisfy ourselves that the globules were present in *Lumbricus* cells, *intra vitam*, without staining, or after osmic acid. It does not seem possible entirely to dismiss the idea that these globules might be segregation vacuoles and not pre-existing structures. Possibly many neutral red staining globules are segregation vacuoles and have been confused with the neutral red vacuoles of such animals as *Abraxas* and *Cavia*, where there is, before staining, a definite pre-existing aggregation of globules. We have also succeeded in staining a 'vacuome' in nerve cells of *Lumbricus*.

One point we should like to stress. These vacuoles filled with neutral red dye are not related in any way to the argentophile and osmiophile bodies, which can be seen *intra vitam* in the earthworm ovary and nerve cord, and are known as Golgi elements. The mitochondria, the neutral red globules, and the Golgi elements can be seen side by side separately (Fig. 1, B).

MAUREEN O'BRIEN.
J. BRONTË GATENBY.

Trinity College, Dublin,
May 15.

Fechner's Law.

THE power of the eye to distinguish differences in brightness has hitherto been specified by the ratio $\Delta I/I$, where ΔI is the least perceptible increment in brightness when the eye is observing a surface of brightness I. Weber stated that the ratio was constant, and this statement has been known as Weber's law or Fechner's law. It was obvious to Fechner that the law did not hold for high and low intensities. But he considered that these deviations were due to disturbing factors, dazzle at high intensities, and the intrinsic light of the eye at low intensities.

In a recent paper (*Phil. Mag.*, **8**, p. 520; 1929) R. A. Houstoun suggested that the reciprocal of Weber's ratio was a Gaussian probability curve when

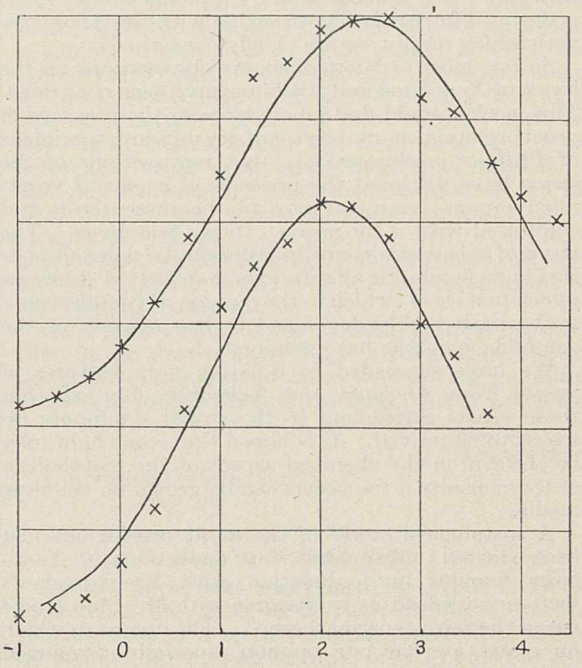

FIG. 1.

plotted as a function of the logarithm of the intensity. We have tested this point, and a full description of the experiments will be published in due course, but we think it desirable to state here, in view of the number of physiologists and psychologists interested in the matter, that $I/\Delta I$ forms a good probability curve. The accompanying diagram (Fig. 1) shows typical sets of observations for red light, the abscissæ giving logarithms of the intensity and the ordinates $I/\Delta I$. In the interests of clearness, the zero of the one curve has been displaced vertically upwards. The curves are probability curves fitted to the results. The observations for blue light agree with those for red except at low intensities, where there is a deviation if the eye is dark adapted.

It may be shown that the sensation at any intensity is proportional to the area to the left of that intensity, and that the obvious interpretation of the observations

is that we are dealing with a group of percipient elements, forming a homogeneous population, which come over the threshold as the intensity is raised.

R. A. HOUSTOUN.
JAMES F. SHEARER.

University, Glasgow,
May 10.

Presence of a Yeast in the Death Watch Beetle (*Xestobium rufo-villosum* De G.).

IN a letter on the above subject in NATURE of April 26, p. 635, Mr. L. N. Staniland directs attention to the presence of yeast symbionts in *Xestobium* in connexion with the work of our colleague, Mr. W. G. Campbell, on the chemical aspects of the destruction of oak wood by powder-post and death watch beetles, *Lyctus* spp. and *Xestobium* sp. (*Biochem. Jour.*, **23**, No. 6, pp. 1290-1293; 1929).

A study of symbiosis in relation to certain wood-boring beetles has been started by this laboratory in order to check and add to the results of the earlier workers, Karawiew, Escherich and Buchner, and of the more recent investigators, Heitz and Breitsprecher. The work of the last named (*Zeitschr. f. Morphol. u. Ökol. der Tiere*, **2**, parts 3 and 4, pp. 495 *et seq.*; 1928) is the most important in connexion with the Anobiidæ, with which family we are chiefly concerned.

So far, most of Breitsprecher's observations on the larvæ of *Xestobium* and *Anobium* have been confirmed. This worker could find no evidence of the presence of yeast organs in the ovipositor of dry museum specimens of *Ptilinus pectinicornis* L., but our sections of the larvæ have disclosed the presence of a pair of yeast-filled organs lying anterior to the mesenteron and connected with it by means of very fine ducts. The larva of this beetle seems therefore to be more specialised in its symbiotic adaptations than that of *Anobium punctatum* De G., which in the opinion of Breitsprecher is the most highly developed in this respect of the Anobiids which he has examined.

We have succeeded in isolating pure cultures of yeasts from *Anobium* and *Xestobium*, but whether these yeasts correspond to the actual symbionts remains to be proved. It is hoped that some light may be thrown on the chemical aspect of the metabolism of these insects if the yeasts can be grown on cellulose media.

A histological study of the adult beetles has just been started. Meanwhile, our dissections of *Xestobium* females in conjunction with Breitsprecher's section work lead us to disagree with Mr. Staniland's use of the term 'spermathecae'. The organs to which he refers are, in our opinion, specially developed structures; the spermatheca with its associated gland is quite distinct and occupies a normal position for most Coleoptera, that is, just anterior to the bursa copulatrix.

RONALD C. FISHER.
E. A. PARKIN.

Entomology Section,
Forest Products Research Laboratory,
Princes Risborough, Bucks,
May 9.

Raman Effect in Metallic Halides.

IT is known that the crystalline halides of the alkali metals (for example, rock-salt) fail to exhibit the Raman effect. With the view of elucidating the reason for this behaviour, I was led to examine a series of other crystalline metallic halides, using the technique described in a recent note (NATURE, Mar. 22, p. 463). Amongst the numerous solids examined, the two chlorides of mercury stand out conspicuously, giving Raman lines of great intensity corresponding to both positive and negative shifts of frequency (Figs. 1 (*a*) and (*b*), lines marked with arrow, the exciting line being 4358 A.).

When we compare the highly contrasted behaviours of the chlorides of mercury and of the alkaline halides, and remark that mercurous chloride is insoluble in water, and that mercuric chloride in solution is a poor conductor of electricity, the inference is suggested that the electrovalent type of chemical union between atoms is unfavourable, while on the other hand the covalent type of linkage is highly favourable, for the production of the Raman effect. This

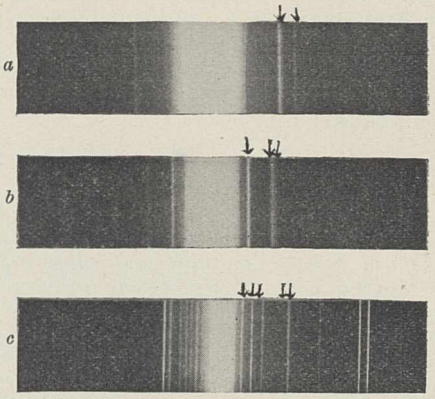

FIG. 1.—Raman spectra of (*a*) mercuric chloride, (*b*) mercurous chloride, and (*c*) sulphur.

inference is supported by all the evidence obtained by me. It is found that lithium, barium, and thorium chlorides give no observable effect. On the other hand, the solid trichlorides of antimony and bismuth give strong Raman lines, while auric chloride, cadmium iodide, and anhydrous zinc chloride give just detectable lines of feeble intensity. The contrasted behaviour of stannous and stannic chlorides is also an example worthy of special mention. The former gives no new lines, while the latter is a liquid which gives an extremely strong Raman spectrum.

Fig. 1 (*c*) is the Raman spectrum of ordinary rhombic sulphur with the green line of the mercury arc as the exciting radiation. It is of interest as showing that the Raman effect may be successfully photographed even with strongly coloured solids.

P. KRISHNAMURTI.

210 Bowbazar Street,
Calcutta, India.

Raman Effect of Sulphuric Acid.

USING incident mercury light, the Raman effect of sulphuric acid at varying concentrations has been studied. In the results below, 100 per cent is the purest acid obtainable; 50 per cent is 1 molecule of sulphuric acid to 1 molecule of water; 0 per cent is pure water.

At 100 per cent, Raman lines were obtained at 4585 A., 4566, 4542, 4470, 4438, 4276, 4252, 4224, 4203, 4171, 4142. These decreased in number and intensity at 90, 80, 70, and 60 per cent, until at 50 per cent the lines found were 4566 A., 4542, 4470, 4438, 4224, 4203. At 40 per cent, Raman lines were found at 4566 A., 4547, 4474, 4441, 4224, 4203. At 30 per cent no lines were found, but weak bands were present, which were probably due to the water, for they increased in number and intensity at 20, 10, and 0 per cent.

Forty-five per cent concentration gave the same results as 50, and 35 the same as 30. The sudden change between 45 per cent and 35 may indicate that

a large number of molecules are broken up into ions between these points. Some of the lines found at 40 per cent may be due to sulphate ions. Most of the lines in pure sulphuric acid were easily obtained in a three-minute exposure and the strongest appeared in a one-minute exposure. For other concentrations fifteen minutes was sufficient.

RAYMOND M. BELL.
W. R. FREDRICKSON.

Syracuse University,
Syracuse, New York, May 9.

The Swimming of Cuttlefish.

IT may not perhaps be generally realised that the common cuttlefish, *Sepia officinalis*, uses its siphon for slow swimming in all directions, as well as for the more violent backward leaps. We recently had an opportunity of watching the behaviour of cuttlefish which were swimming at eye level and above our heads in one of the large tanks of the Plymouth aquarium. We were rather surprised to notice that while moving slowly forwards with its fins undulating, the cuttlefish had its siphon curved back ventrally and was assisting its forward motion by emitting gentle squirts of water (Fig. 1, A). If the cuttle wished to turn to one side it would point its siphon opening to the opposite side and squirt a little more violently (Fig. 1, B). In fact, for all its general slow movements the siphon appeared to be used, the undulations of the fins merely keeping the motion continuous and preserving the balance. In the quick backwards swimming the fins were depressed along the side. The siphon was extended about an inch and a half and could be pointed in any direction.

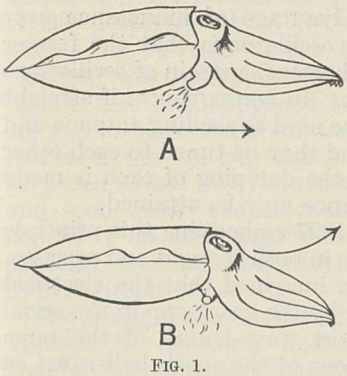

FIG. 1.

F. S. RUSSELL.
G. A. STEVEN.

Marine Biological Association, Plymouth.

Echo Sounding and Depths.

IT is to be feared that the note on page 473 of NATURE of Mar. 22 may lead to some misunderstanding and to conclusions unfavourable to the echo method of sounding. Dr. Maurer states that out of 254 comparative soundings made by wire and echo in water over 2000 metres deep no less than 36 showed differences exceeding 100 metres and that the maximum difference was 650 metres. It should not be overlooked that a part, possibly a large part, of the error may be due to the curvature of the wire when the ship was drifting, for it is known that as a rule the depth by echo is less than that by wire even when the bottom is regular. Dr. Maurer also considers that the crude echo distance, calculated on a constant velocity, is more useful to the seaman for fixing his position.

It scarcely seems probable that deep soundings would ever be used for fixing a ship's position, except possibly cable or surveying ships, so that to the ordinary navigator the difference between corrected and uncorrected soundings would be of no importance.

In coastal water where the depth, or better, the rate of change of depth, gives valuable information in thick weather, the correction is of small practical importance when expressed in fathoms or metres, except in some places such as the Red Sea. Special warnings are inserted on the Admiralty charts in such cases.

The Supplementary Hydrographic Conference, which was held at Monaco in 1929, resolved that all soundings should be corrected so far as possible before being placed on the charts, and did not adopt a standard velocity of sound in sea water.

H. P. DOUGLAS
(Rear-Admiral and Hydrographer of the Navy).

Hydrographic Department,
Admiralty, London, S.W.1, May 3.

The Ions Produced by Discharges at Liquid Surfaces.

WE regret that, in our paper (*Proc. Roy. Irish Acad.*, 39, A, p. 21) in quoting Prof. Zeleny's description of the discharge from an alcohol point in the form of a stream of minute drops, we did not make it clear that this description applied only to discharge under the conditions of instability indicated in his letter in NATURE of May 10. We are in agreement with Prof. Zeleny that the discharge from a stable liquid surface is similar to that from a metal point; we find that it is carried by ions of the ordinary kind. But although we have observed the conditions of surface instability and the transport of liquid mentioned by him, we have been unable, under the conditions of our experiments, using water and a number of alcohols, to find any evidence by Chattock's method of the big drag on the gas which discharge currents carried altogether by drops should produce. We find evidence only of ions, which for a life of about 1/5000 sec. have mobilities similar to those of ions produced in air by the ionising radiations.

On the other hand, in recent work, we have observed that in air drawn away from a discharging water-point, there are present large ions having mobilities at least as low as those of the large ions of Langevin.

J. J. NOLAN.
J. G. O'KEEFFE.

University College, Dublin,
May 16.

Slug or Horned Viper?

As my name was mentioned by Prof. T. D. A. Cockerell in his letter in NATURE of May 17 on the identification of a certain animal represented among the incised carvings at Karnak, may I point out that the figure in question is the Egyptian hieroglyph for the letter F? I am informed by my colleague, Mr. A. Shorter, of the Department of Egyptian and Assyrian Antiquities, British Museum, that the animal portrayed in that symbol was identified as a slug so long ago as last century, the identification being based on a representation published by Prisse (1847), but that it has been more commonly recognised as the horned viper (*Cerastes cornutus* (Linn.)). The 'horns' in the figure, if somewhat exaggerated, are like those of the viper and do not resemble the tentacles of a *Veronicella* (the slug which has been suggested), in which there are in fact two pairs of these appendages. The clearly defined head and slender 'neck' which are shown in the Karnak figure are not found in *Veronicella*.

G. C. ROBSON.

Zoological Department,
British Museum (Natural History),
Cromwell Road, London, S.W.7,
June 3.

Physics in Relation to Wireless.*

By Dr. W. H. ECCLES, F.R.S.

THE preparatory research work for the transmitting station, that is, for generating electromagnetic waves, was done by Hertz in the years 1885–88, and appears to have been prompted by the rivalry between the extant theories of electricity and magnetism. The laboratory work for the receiving station was done by Lodge in 1889, by Minchin and by Branly in 1890. Lodge's work on the reception of electric waves arose from observing that two metal knobs nearly in contact cohered when a spark occurred near them ; Minchin's work was on light sensitive cells and his observations of the effects of electric waves was a side issue, but was duly recorded ; Branly's investigations were on the diminution of the electrical resistance of contacts between oxidised metals and in masses of filings when sparks were made near by.

Without asking which physicist we are to thank for each of the items needed for making a complete sending and receiving equipment for wireless telegraphy, we know that Oliver Lodge demonstrated the transmission of signals across a space of 30 yards and through several walls at the Royal Institution, London, on June 1, 1894. On this occasion a filings coherer was used, and the necessity of screening various portions of the receiver and its leads, which later became part of early wireless engineering, was emphasised. Later in 1894, during the summer meeting of the British Association at Oxford, Lodge demonstrated the sending and recording of Morse code signals. He used a Hertzian oscillator with large copper plates as capacity areas, an induction coil with the usual vibrating interrupter and a Morse telegraphic key in the primary of the coil. As receiver he used a filings coherer with attached aerial wires for picking up the waves, a trembler of electric bell type operated by the coherer current and serving to shake the filings back to their non-conductive condition, and a Morse inker for recording the dots and dashes on tape. Other telegraphic instruments were employed as alternatives. The following year Popoff, a Russian physicist, added to the recording apparatus a long earthed vertical antenna for catching natural electric waves produced by distant lightning discharges ; he had possibly adopted the vertical wire from the patents of Dolbear and other American inventors.

By 1895, therefore, every item was ready for the attention of the engineer ; some parts of Lodge's apparatus had to be made more powerful, other parts more sensitive, and all of it more trustworthy and robust before it could be put into the hands of telegraphists for everyday use. Improvements came rapidly, and the range of action was gradually increased, but progress was limited by the use of highly damped trains of waves. At this date the spark gap at the sending station was situated in a long vertical wire, possibly surmounted by a large metal plate, and the coherer was in another similar antenna at the receiving station. Such an arrangement had a high decrement and therefore *any* transmitting station affected *every* receiving station within range, and only one pair could work at a time.

In Europe, so far as printed records can tell us, the earliest use of ' tuning ' coils in open oscillating circuits was due to Lodge, who appears to have satisfied himself by laboratory experiments in 1896 and 1897 not only that inductance coils were useful in a Hertzian oscillator for adjusting frequency, but also that their employment brought certain advantages over the method of adding capacity areas. The main advantage of inductance over capacity in an open oscillator is that the former prolongs, the latter shortens, a strain of oscillations produced by a spark. In consequence, if straight Hertzian oscillators be used as sending antenna and receiving antenna, and they be tuned to each other by inductance coils, the damping of each is made low and sharp resonance may be attained.

Lodge's patent in 1897 embodying this principle produced a revolution in both thought and practice. Hitherto it had been imagined that the electrical oscillations produced by the spark gap in the aerial possessed a very short wave-length of the same order as the dimensions of the spark balls, just as in the case of the Righi oscillator ; and the function of the transmitting antenna had been explained by supposing that the Righi waves ran up the wire and squirted out at the top. This seemed to explain why high wires were needed for long ranges. But now it was seen that the high wire vibrated as a Hertzian oscillator with a wave-length of the same order of magnitude as the length of antenna, and that range of signalling was related to length of wave. Moreover, Lodge's patent specification disclosed a scheme for exciting a metallically continuous antenna from a spark in a branch circuit, thus contradicting the accepted idea that radiation was impossible unless the spark was formed in the antenna. Stranger still, the receiving antenna was shown as a continuous straight oscillator with its tuning coil acting as the primary of a high frequency transformer, the coherer being connected into the secondary circuit. Being, in fact, a mine of scientific information and suggestion, Lodge's specification furnished during several succeeding years all the fundamental ideas employed by the engineers who developed commercial signalling plant of the spark type.

In illustration of the last statement and to put on record another triumph of the laboratory, I may cite the important development known as the quenched spark transmitter. The germ of this appears in Lodge's patent, where it is explained that an antenna would become a more persistent oscillator if it were excited by a short-lived spark in a side circuit. The cessation of the spark automatically frees the antenna from the branch circuit

* From the presidential address to the Institute of Physics entitled "The Influence of Physical Research on the Development of Wireless", delivered on May 27.

and from the dissipation of energy in it. The idea was improved upon by Max Wein in 1906, who, for the purpose of his laboratory measurements, invented a form of gap that ensured rapid quenching. This was developed by the Telefunken engineers into a type of transmitter that has seen world-wide service.

From the year 1900 onwards the more alert workers in wireless sought about for a method of generating continuous waves. The hope of achieving wireless telephony was the incentive, for no one at that time foresaw that continuous wave telegraphy by the Morse code could be better than spark telegraphy. The problem was to devise a method of generating continuous waves of frequency at least 100,000 cycles per second. The physicists' solution came from an unexpected direction, namely, from the scientific investigation of the properties of an electric arc traversed by alternating currents of low frequency. In 1900, Duddell was pursuing these investigations on carbon arcs and happened to connect across the arc gap an inductance coil and condenser in series just as if the arc gap was a spark gap. He was surprised to find that the arc whistled when ignited, and soon discovered that the pitch of the note depended on the magnitudes of inductance and capacity of the shunt circuit in the same way as in a spark circuit.

The study of the oscillating arc was taken up by Poulsen in Denmark and he investigated the Duddell phenomenon when the arc burnt in various gases and between various electrodes. By 1903 he discovered that an arc burning in hydrogenous vapour between a copper anode and a carbon cathode was capable of developing currents of frequency required for radio-telephony and of considerable power. This splendid discovery led straight to practical radiotelephony.

Fessenden invented the heterodyne method of receiving telegraphic signals. The method relies upon the employment of a local source of electrical oscillations near enough in frequency to that of the incoming wave to produce in the receiving circuits regular increases and decreases of amplitude at an acoustic frequency. The conception comes straight from the storehouse of acoustic theory, and could only have arisen in the mind of a student and teacher of physics, like Fessenden. It is, in my opinion, one of the four or five universally important steps in the history of wireless technique.

The most striking example of the discontinuity of the progress of wireless is afforded by the maturing of the amplifying vacuum valve.

The first vacuum tube containing a hot filament and a separate electrode with external lead, that is, the first thermionic diode, was made by Edison in 1883. Studies of the thermionic current across the vacuum were conducted by Hittorf (1883), Preece (1884), Elster and Geitel (1887), and Fleming (1889 and 1896). Three years later J. J. Thomson's laboratory took up the problem and, in particular, O. W. Richardson during the next three years pursued his classical researches, usually employing a form of diode that has become typical, namely, a straight filament along the axis of a cylindrical anode. Meanwhile an analogous form of diode in which the source of electrons is a photo-electric surface was being similarly studied. Many of the researches of the date were aimed at measuring the charge and the mass of the particles carrying the current across the vacuous space; and for this purpose other electrodes were sometimes introduced for deflecting the particles by an electric field. Lenard, in 1902, used an anode of wire gauze so that light could pass through it to the cathode and liberate electrons; Wulf later used a flat spiral of wire, parallel to the photoelectric cathode for the same reason; Varley in 1903 observed that when the gas pressure was below about five microns the electrons could be accelerated towards a positive grid so as to be shot through the meshes of the gauze. At higher pressures ionisation by collision occurred near the grid and gave such tubes their steep characteristic curves. Besides all this experimental work of an abstract nature, various applications of the electric discharge through gases had been made to the rectifying of alternating currents. Thus the scientific atmosphere of the first three years of the twentieth century was thick with material ready for useful applications.

The first application of vacuum tube physics which I have to notice was made by the well-known German physicist Wehnelt, who, having discovered in 1903 that filaments coated with oxides of rare earths emitted electrons copiously, patented a diode with coated filament as a rectifier in January 1904. He called this thermionic diode an electric valve. It is sometimes said that Wehnelt invented the thermionic valve—but this is a fallacy; he invented the coated filament, and he invented the name, perhaps, but thermionic tubes with two electrodes had long been commonplaces in physical laboratories. It is noteworthy that, apart from the valuable invention of the oxide coating, Wehnelt's application is widely used to-day at many transmitting stations for rectifying alternating current and in the so-called 'battery eliminators' of broadcasting sets. About eleven months after Wehnelt, Fleming patented the combination of a thermionic diode, a coil and an indicating instrument, to form a circuit in which alternating current could be produced and rectified, special stress being laid on the applicability of the circuit for detecting by rectification the feeble alternating currents experienced in wireless receivers. The diode as detector was in the field for several years as a rival to the electrolytic and contact detector. The third interesting application of vacuum tube physics was made a year later by von Lieben, who proposed to utilise the lateral deflection of a stream of electrons as an amplifier. The current to be amplified was intended to cause the deflection—either by charging an auxiliary electrode which then attracted or repelled the stream, or by producing a magnetic field. The fourth application was made a year later in America by de Forest, who, by means of an auxiliary electrode in the form of a grid, controlled the passage of the electrons to an anode by accelerating or decelerating them in their line of motion.

This method of control proved, in the course of a few years' development, more effective for amplifying purposes than the method of control by lateral deflection.

The introduction of the von Lieben and the de Forest tubes is specially notable because these instruments were not alternatives to existing ones but were novel in purpose as well as in principle. Von Lieben at any rate—de Forest seemed to be rather vague—clearly appreciated that an inertialess magnifying device was in his hands—the first distortionless repeater in history. Unfortunately, neither form of instrument became an immediate practical success, perhaps because evacuation was not pushed far enough. Von Baeyer was probably nearer success than either; for independently of de Forest, in 1907 he constructed a triode of ideal modern form containing a cylindrical anode two centimetres in diameter, a coaxial gauze cylinder one centimetre in diameter, and a filament in the common axis of the cylinders, and more highly evacuated than de Forest's tubes appear to have been. But von Baeyer was engaged on the study of the motion of the electrons from the incandescent filament, and never applied the excellent amplifying functions which it undoubtedly possessed.

The key to the situation was really lying all the time in Varley's remark in his 1903 paper, that electrons did not pass through the grid in quantity until the vacuum was below five microns. However, during these years the physical laboratories intent upon the study of electricity at extreme exhaustions developed several methods of producing and retaining very high vacua. In the years 1912 and 1913, Langmuir, working in the laboratory which also evolved the Coolidge X-ray tube, gave the triode a more stable behaviour by resorting to extreme rarefaction.

The technical value of the high vacuum triode rests upon its ability to magnify very small and very rapid electrical changes with close fidelity. An electromotive force applied to the grid causes inappreciable current flow but liberates a magnified electromotive force in the anode circuit where relatively large currents are possible. The development in size of triodic oscillation generators made them feasible for the transmission of signals, while small sizes improved reception—a remarkably happy concatenation.

After this last revolution in wireless technique, later developments in the apparatus and methods of radio communication seem relatively undramatic. For my present purpose I need only give one or two examples, with which I am very familiar, of the influence of the physical laboratory. There are two methods of generating electrical oscillations for transmitting stations which have appeared as alternatives to the back coupled valve method, and have been adopted in large short wave stations all over the world. The first is the crossed valve method, which was devised in the physical research laboratories of Finsbury Technical College in 1916–17 at the request of the Signal Experimental Establishment of our War Office. It was intended for use over short distances behind the trenches on wave-lengths of 50 metres and less.

The second method aims at generating electrical oscillations of very constant frequency by aid of massive bodies sustained in mechanical vibration by triodes. The earlier apparatus for this purpose was the tuning-fork alternator, which was developed in 1918 for delivering fundamental and harmonic frequencies for the purposes of measurement in the physical laboratory. A later apparatus arose out of the growth of supersonic under-water signalling in 1917. In the autumn of that year Langevin in France and Rutherford in England independently suggested that the piezoelectric qualities of quartz might be utilised for perceiving the arrival at a receiving station of pressure waves in water and for producing such waves at a transmitting station. Langevin's work at Toulon was supplemented by his collaborators at Finsbury Technical College and Harwich, and at Finsbury this led, first, to an appreciation of the fact that quartz vibrating under the stimulus of a feedback circuit steadied the electrical oscillator, and, later, to a triode circuit for automatically sustaining quartz in vibration at its natural frequency in water without the use of back coupling. At about the same time, we learned later, Nicholson in the New York laboratory of the Western Electric Company, devised an equivalent method of vibrating piezoelectric crystals such as Rochelle salt in air by aid of a triode. Thus came about what may be called the marriage of mechanical and electrical oscillations, the so-called 'stabilisation of frequency', which plays so large a part to-day in wireless stations, large and small.

My account of the contributions of physicists to wireless omits all reference to the great engineers who have adorned the industry, as otherwise this address would become a complete history of wireless, but I must refer to the effect upon practical wireless of the study of the electrical properties of our atmosphere—a branch of geophysics—which has already assisted practical operation of telegraphic circuits. In Great Britain the study has been pursued under the auspices of the Radio Research Board and independently by T. L. Eckersley. In my opinion the cumulative effects on radio communications of these researches will disclose itself in the near future.

A valuable geophysical discovery made neither by physicists nor engineers was the phenomenon that short waves could travel long distances. Short wave transmitting and receiving apparatus was much used during the War, for example, 50 metres for trench sets and less than 20 metres for aeroplanes, in several of the belligerent countries; short waves had been tried for telephony across a hundred miles of the North Sea and between London and Birmingham overland, but were not suspected of shooting aloft and coming down thousands of miles away. We now know that trials made within the skip distance were inevitably misleading. However, before 1920 all the technique of short wave telegraphy and telephony was complete. As a mere chance, amateur wireless enthusiasts were officially relegated in most countries

to transmission experiments on waves shorter than 300 metres. Gradually widely scattered amateurs began to overhear signals exchanged between two very distant colleagues. In 1921, American amateurs transmitted to British amateurs on wave-lengths of 200 metres; this was reciprocated in 1922. Meanwhile the American amateurs had found shorter waves better, and in 1923 were communicating easily with other amateurs across world-wide ranges. The first commercial application was made in the autumn of 1923 and has been followed by universal adoption of short-wave signalling. It is a remarkable example of a revolution in method which was not due to, and did not require, any change of technique—a revolution effected by pure discovery.

The Concept of Space.

ON Friday, June 6, Nottingham was honoured by a visit from Prof. A. Einstein, who delivered a lecture (in German) in the Great Hall of the University College. After each section an English translation was given by Dr. H. L. Brose. The chair was taken by Prof. H. H. Turner. The lecture was an account of the history of the concept of space, and was addressed to a general audience. At the end questions were invited: those received were all concerned with the present position of the unitary field theory. For the following impression of the lecture I am deeply indebted to Miss Dallas and Miss Lieber for their help, but for any inaccuracies I alone am responsible.

At the outset Prof. Einstein emphasised that he was not making an authoritative pronouncement, but merely stating his own personal opinions. He believed that the fundamental concept of physics was that of the rigid body. The idea of space was not acquired until a much later date, and was not known to the ancient Greeks. Euclid's geometry, in particular the part dealing with the congruence of triangles, was based upon notions of rigid bodies, such as measuring rods which could be moved about as a standard of comparison. Motion appeared first, not as in space, but as that of one body relative to another. The concept of space was introduced by Descartes, the founder of co-ordinate geometry. This was a purely mathematical notion, without any physical implications, and concerned only with the geometrical aspect of the relative position of two or more bodies. The other aspect of space was due to Newton, who considered the bodies, not at rest, but in motion. To deal with the problem of acceleration he introduced the idea of an absolute space, forming a framework by which the motion of the bodies could be measured, but itself quite unaffected by those bodies. It was a wonderful thing that Newton's genius enabled him to realise the definitely physical reality of space. This reality has been neglected or misunderstood by many of his successors, including the philosopher Kant.

However, in Prof. Einstein's opinion, the really decisive change from the geometrical to the physical conception of space was due to Faraday and Maxwell, who considered electromagnetic phenomena to have their seat in the ether, and spoke of the field or the state of this ether as affected by electromagnetic action. Why did they think it necessary to use a new word ether, when the old one space was already available? The reason, no doubt, was that they were fettered by the ideas prevailing in their day, and had not realised the connexion between the space of geometry and the space of physics. As material bodies were the first objects to be considered in physics, they introduced the idea of a material ether to replace what was formerly considered as empty space, through which electromagnetic action took place. This idea was developed by Lorentz, in whose view all electromagnetic action, even that in the interior of material bodies, really took place in the ether. Thus he deprived matter of all its electromagnetic properties, but to compensate for this he deprived ether of all its mechanical properties, and attributed a capacity for motion only to the elementary particles of matter.

The next modification was the special theory of relativity. Classical physics used three co-ordinates in space and one in time. It was now found necessary to unite these into the four co-ordinates of space-time, and to give up the belief that events could be divided into categories of 'before', 'simultaneous', and 'after'. This prepared the way for the general theory of relativity, which dealt with the phenomena of inertia and derived the laws of motion from the geometrical structure of space, or rather of space-time, thus uniting geometry and physics in a new intimacy. The experimental verification of this theory is well known. We have now come to the conclusion that space is the primary thing and matter only secondary; we may say that space, in revenge for its former inferior position, is now eating up matter.

With regard to the unitary field theory, the purpose of which was to derive all physical phenomena, electromagnetic as well as gravitation, from the properties of space, Prof. Einstein confessed that his colleagues did not agree with him. In fact, he added with a smile, they think that I am crazy on this subject. However, he himself had faith that the idea (which came to him during a severe illness two years ago) of attributing direction as well as metrical structure to space would ultimately lead to success in obtaining a single theory to embrace all phenomena. He regarded this as a true physical theory, not as a mere mathematical curiosity. It was best to leave aside the difficulties of the quantum theory for the present, but he hoped that when the simpler problem of

matter in bulk was solved the more difficult ones relating to atomic physics could speedily be dealt with. The urgent thing at present was to obtain the equations of motion of an electron or proton. Although the theory was not yet finished, he firmly believed that the end was very near.

Amid enthusiastic cheers, Alderman Huntsman, chairman of the College Council, announced that the blackboard used by Prof. Einstein and signed by him would be varnished and preserved in memory of a historic occasion.

H. T. H. PIAGGIO.

Obituary.

PROF. K. J. P. ORTON, F.R.S.

HIS friends even now find it more than a little difficult to realise that they have looked their last on Kennedy Orton—his vigour and freshness of mind and body, his keenness in attack on any problem, scientific or administrative, had suffered so little diminution with the passing of the years, that those who knew him well looked forward with no thought of the end to that stimulating interchange of ideas, to those talks ranging from China to Peru, which now are fated to remain but cherished memories.

Orton was a born man of science. Intended for a medical career, he found that the microscopical work involved was likely to prove too severe a tax on his eyesight, and he turned to the study of pure chemistry. As a scholar of John's he worked at Cambridge from 1891 to 1895 under Liveing, afterwards proceeding to Heidelberg, where he took his doctor's degree *summa cum laude*. Victor Meyer's attractive personality left a deep mark on Orton's character, and one is tempted to speculate on the rapidity of thought, the energy and versatility, the power to pick out underlying resemblances from surface differences, the single-hearted devotion to the pursuit of knowledge for its own sake, which were common characteristics in the mentalities of master and scholar.

He returned to London master of a wide range of chemical philosophy, and already interested in the properties of and mechanism of substitution in halogen compounds of benzene derivatives; well versed in laboratory technique; a skilled worker in glass. In truth, he always retained keen interest in carefully planned and neatly executed laboratory work, and if ever he showed appreciation of his own powers it was when, with justifiable pride, he recalled instances of the evolution of skilful and enthusiastic researchers from distinctly unpromising material.

For six years he worked as demonstrator in chemistry at St. Bartholomew's Hospital, and in 1903 he was appointed to succeed Dr. J. J. Dobbie in the chair of chemistry in the University College of North Wales. The deep and accurate knowledge, the administrative ability, the sympathy for, and understanding of the student mind that he brought to his task at Bangor are well known to those whose good fortune it was to serve with him or to be taught by him, and his election to the Royal Society in 1921 testified equally to the value of his own researches and to the influence of the school of chemistry which he directed.

Orton's output of research was large—the general index of the *Journal of the Chemical Society* marks sixty-two titles under his name between 1897 and 1922. Looking over these and his later papers, one is struck by the clearness of their outlook—there is a refreshing absence of ragged edges, of untidiness or diffuseness of thought, diction, or method. The problem is clearly stated, attacked by well-planned experiments, and the result, positive, negative, or doubtful, is set out in vigorous language free from the slightest trace of ambiguity.

Substitution in aromatic compounds, and the problems involved in the theory of the intra-molecular migration of atoms had early occupied his attention, and during his time in London he had, in conjunction with Chattaway, attacked such problems as the substituted nitrogen chlorides and their rôle in the halogenation of anilides and anilines. About this period, too, his work on the action of light on nitrogen iodide shows his interest—an interest which never left him—in the efficacy of light in promoting chemical change.

A remarkable research, carried out at Bangor, showed that the migration of halogen in substituted acyl-anilides is dependent on the intermediate liberation of chlorine,

$$C_6H_5N.Cl.Ac + HCl \rightleftarrows C_6H_5NHAc + Cl_2$$
$$\rightarrow C_6H_4Cl.NHAc + HCl.$$

This work threw great light on the mechanism of the reaction, and confirmed Armstrong's general view that hydrochloric acid is the catalyst. Orton turned again and again to the consequences of this work, developing therefrom a method for the regulated chlorination of aromatic substances, and for the production of an acetic acid solution of known chlorine-concentration.

In collaboration with his students he carried out much valuable work, involving studies of the mechanism of acetylation and of halogenation, on acetic acid and acetic anhydride. He consistently applied physico-chemical methods to the elucidation of the mechanism of organic reaction, and in some of his later work turned to the more purely physical side of his science, as is shown by his development with D. C. Jones of the technique of work on the mutual miscibility of liquids and of the determination of critical solution temperatures of ternary mixtures as a criterion of purity.

Orton was, however, much more than a chemist, and any survey of his activities limited to the chemical side of his life's work would present but a warped view of his character. His busy life left him but scant leisure, and the greater part of such spare time as he could command was devoted to

rock-climbing and to the study of the habits and movements of birds. In this last-named region he was an acknowledged authority, and though his chapter on "Bird Life in the Mountains" in Carr and Lister's "Snowdonia" gives some adumbration of his powers, it is a matter for regret that he has not left more detailed records of his bird-lore.

Withal he had a critical knowledge of much that is best in our national literature, and, realising his reticence in certain directions, his intimates discovered with keen pleasure that a treasured volume of Arnold's poems was a constant companion in his wanderings over the Sussex downs.

Orton's view of the function of a university was no narrow one, and he saw, more clearly than many men of science, the danger of losing the cultural value of a university training that comes from laying over-emphasis on the specialist's work and on that technological side of a student's labours which is concerned with preparation for living rather than for life. His interest in his students was unflagging and their graduation did not set a period to that interest. On more than one occasion has an old pupil found the helping hand outstretched even before he had thought of turning to his teacher; and, veteran or recruit, no one could go to Orton for advice or help without feeling that he was giving of his best.

Truly his days were in every sense full ones, and if in rare moments depression seized him, it was because he, more than most, realised what deep significance Νὺξ γὰρ ἔρχεται bears.

> For at my back I always hear
> Time's wingéd chariot hurrying near.
> And yonder, all before me, lie
> Deserts of vast eternity.

It is small wonder that, urged by his ever-present sense of the fleeting of time, he so grievously overtaxed his natural powers that pneumonia found him with no reserve of strength to resist its advances, so that after a few days' illness he died peacefully on Mar. 16.

He rests in a wind-swept Anglesey churchyard, with the waters of the Menai lapping at his feet, and the mountains he knew so well heaving aloft their vast masses on the sky-line. Deeply as we mourn the cutting-short of a life in the plenitude of its powers, regret is assuaged by the thought that Orton had crowded into his fifty-seven years a record of work well worthy of one privileged to live beyond three-score years and ten.

ALLAN FERGUSON.

MR. A. S. HIRST.

MR. ARTHUR STANLEY HIRST, whose death at sea on May 4 was reported from Colombo, was formerly an assistant keeper in the British Museum (Natural History). He was born in 1883, and was the son of the late Dr. Albert Hirst, of Hackney. He was educated at Merchant Taylors' School and studied zoology under the late Prof. Minchin at University College, London.

On entering the service of the British Museum, Hirst worked for some time in the mammal room, but was afterwards placed by Sir Ray Lankester in charge of the collections of Arachnida and Myriopoda. He studied various sections of these extensive groups and published a long series of systematic papers on them, but latterly he gave his attention almost exclusively to the Acari or mites, the economic importance of which has led in recent years to a great increase in the number both of specimens and of inquiries reaching the Museum. Hirst's papers on the Acari were marked by great accuracy of description and laborious investigation of detail. Many of them contain facts and suggestions which will one day be found to have contributed much to a scientific knowledge of the group. Especially noteworthy were his identification of the adult form of one of the familiar and troublesome harvest bugs; his demonstration of a tracheal system in the group of mites named from the supposed absence of the system the Astigmata; and his description of the fossil arachnids from the Rhynie chert, the oldest known air-breathing animals.

For some years Mr. Hirst's health had been unsatisfactory, and in 1927, under medical advice, he resigned his post at the Museum to seek relief in the drier climate of Australia. While there he carried on his work on Acari, mainly at the University of Adelaide. It would appear, however, that the relief was only temporary, and his death occurred while he was on his way home to England.

W. T. C.

News and Views.

ON June 5 the Lord Mayor of London unveiled the third of the three windows which have been placed in the little church of St. Ethelburga the Virgin, Bishopsgate, to the memory of Henry Hudson the explorer. It was in this church that Hudson and his crew communicated on April 19, 1607, before setting out on his first voyage. Three years later, in 1610, with faith undimmed by three failures, "he sailed from London in the *Discovery* and met his mysterious and tragic end. His men mutinied and put their captain with eight of the crew out of the ship to perish. That incident, which took place in June 1611, is the one chosen for the subject illustrated in the third window. The first window, unveiled in 1928, was the gift of the Hudson Bay Company, the second was given by some American citizens, while the third is the gift of the citizens of the British Empire.

THE firm of Messrs. W. H. Allen, Sons and Co., Ltd., of Queen's Engineering Works, Bedford, has long been known for its systems of training both for engineers and workmen. Engaged in the construction of high-class machinery for power plants, pumping installations, and for naval and mercantile vessels, and employing some two thousand men, the firm has a constant need for highly trained engineers as well as skilled craftsmen, while the variety of work done provides wide experience for the beginner. The

present head of the firm, Mr. R. W. Allen, was president of the Institution of Mechanical Engineers in 1928, and in his presidential address he referred to the question of engineering training and education, which in the future, he said, would have three very important and difficult tasks. First there was the problem of a suitable training for administrative and managerial positions, which involves not only a knowledge of scientific principles, technical applications, and workshop processes, but also calls for a knowledge of men and a broad view of industry; then there was the problem of the production of craftsmen through apprenticeship, and thirdly there was the training of boys other than craft apprentices. This last category, he said, has been singularly neglected, "but we are realising to-day that from this class of entrant to industry there will be drawn in the future the great majority of the operatives of process work".

How Messrs. Allen have solved these problems is explained in an illustrated booklet recently issued by them entitled "Engineering Training". Briefly, there are four schemes of training dealt with, known respectively as engineering pupilage, senior engineering studentship, junior engineering studentship, and trade apprenticeship, the first being suitable for the university graduate and the last for the elementary schoolboy. Much information is given concerning the time spent in the various departments, the hours of work, wages, holidays, and the like, and an interesting coloured chart shows how the trade apprentice can become a student and how the junior student can become a senior student. But a youth entering Messrs. Allens' not only finds an excellent system of practical training laid down for him but also through the works Education and Welfare Department he is provided with courses of lectures on mathematics and science and on design and production, some of the lectures being given by the heads of departments. There is also a Junior Engineering Society managed by the pupils, students, and apprentices, a past and present students' association, and everything is done to encourage healthy mental and physical culture. The booklet is one which should be of use to all interested in engineering education, especially as it embodies an account of a system worked out with great care which has stood the test of time.

IN the earlier part of his presidential address to the Linnean Society of New South Wales, delivered at the annual general meeting on Mar. 26 last, Dr. H. S. Halcro Wardlaw reviewed the work of the Society during the past year. The notable feature was the successful conclusion of negotiations for the erection of Science House by the Royal Society of New South Wales, the Linnean Society of New South Wales, and the Institution of Engineers, Australia. The building is to be in Sydney on a site specially granted by the Government of New South Wales. It will be a six-storey building and, it is hoped, will be completed by the end of the year. Another point of wide interest in Dr. Wardlaw's address was that the Council of the Society has approved of a scheme to publish, two or more times a year, coloured plates of species of the Australian flora. It was also stated that scientific societies have gained representation on the National Park Trust of Australia in the appointment of Prof. T. G. B. Osborn, professor of botany in the University of Sydney, to fill a vacancy. The Government of New South Wales has again continued the protection granted to species of wild flowers threatened with extinction; while, as one result of Dr. Walkom's attendance at the South Africa meeting of the British Association, the Society has taken steps to attempt to secure the setting apart of an area or areas for the protection, cultivation, and exhibition of the native flora.

THE second part of Dr. Wardlaw's address was devoted to a consideration of some aspects of the adaptation of living organisms to their environment. Dr. Wardlaw said that a characteristic feature of living organisms is the possession of mechanisms which protect them against the effects of changes of their environment. These mechanisms in the earlier forms exert their action by restricting the interchange which they allow between the organism and its surroundings. As they develop in efficiency, they become more selective in action, and are able to preserve the essential characters of the organism while allowing a free interchange with its environment. As the complexity of organisms has increased, they have rendered themselves more independent of their external environment by providing their cells with an immediate environment of their own. By this means external changes are only allowed to reach the cells in a modified form. The evolutionary development of the adaptive mechanisms of the organism has continually extended the range and scope of its control over its environment. Examples of the most highly specialised forms of this control are the maintenance of a constant body temperature by homoiothermal animals, and the provision of a special food supply for their young by mammals. As the effectiveness of the mechanisms for the adaptation of the environment to its needs has increased, the use of adaptive modification of the organism itself has correspondingly diminished. This is expecially the case with man, in his ability to make tools, and in extending and increasing his control over his environment so much more rapidly than would seem possible by evolutionary modifications of bodily structure.

DR. B. T. DICKSON, the first Chief of the Division of Economic Botany, has issued his first annual report as director of the activities of this new scientific venture of the Australian Council for Scientific and Industrial Research (Pamphlet No. 14, Melbourne, 1929). With, as yet, but few staff appointments made, and working in temporary quarters, the activities of this division can scarcely be regarded as fully under way; but the report indicates the lines on which work will be prosecuted, and records good progress, especially in research into some of the serious diseases attacking economic crops. Dr. Dickson outlines a programme of work which includes improvement of existing crops by controlling and eradicating disease, by selection and breeding, and by improved nutri-

tion; the introduction of new plants as the result of exploration or exchanges, and the testing of such plants; the control of weeds; the survey of the plant resources of the Dominion and the records of survey and improvement by adequate herbarium material. It is a comprehensive programme which indicates in an interesting manner the importance of scientific study of the flora of a country. Along some of these lines, as in most plant physiological questions, no start can be made until more resources in men and laboratories are available, but interesting sections of the report, such as that dealing with the effect of harvesting fruit when mature in controlling bitter pit in exported apples, show that on some lines the Division is already doing valuable work to justify the enterprise of the Commonwealth authorities in calling it into existence.

WE are glad that the General Electric Co. Ltd., following the example of several similar manufacturing firms, is now publishing a journal recording its many scientific and technical activities. The researches carried out in its laboratories at Wembley often pass over the borderland of engineering into that of pure science and are of special interest to the scientific world. They also help to keep the undertaking in close contact with the technical colleges and universities from which the Company gets the freshly trained minds necessary for the progress of the engineering industry. The first number is the May issue and it gives amongst other interesting articles a résumé of the electrical progress made during the year 1929. The national grid, 'talkies', illumination, broadcasting, and electric traction have provided numerous problems which the Company has successfully solved. A picture is shown of the plant at Wembley used for testing the great lattice towers used for the grid. Eight pulls of fifteen tons each are applied to them in one direction at various points and a further eight pulls of ten tons each are applied at right angles to the first set. Apparatus has been devised utilising photoelectric cells for the measurement of colour temperature and luminous output. As both temperature and lumen (candle power) scales are linear, the calibration of the apparatus is very simple. The very minute neon indicator lamps the Company has perfected, which take only the hundredth part of the current of an ordinary lamp, should prove useful for showing whether circuits used for cooking, heating, etc., are connected or not, and also for indicating in the dark the position of any object such as a switch. In addition, the Company makes ten-kilowatt lamps for use in cinema studios each equal to 200 ordinary lamps. Details are also given of the large turbo-alternators the Company constructed and of the 350 h.p. Diesel-electric locomotives made for the India State Railways.

THE Annual Report of the Royal Scottish Museum for 1929 indicates the advance that one has come to expect from that progressive institution. Two new halls have been opened, one containing collections of European arms, the other beasts of prey, and exhibits are being prepared for a new gallery which is to be devoted to the illustration of evolution. For the second year in succession the number of visitors has exceeded half a million, and the average attendance on the three open hours of Sunday afternoon exceeds 4000, an indication of the popularity of the collections. It says little for the appreciation in which the Royal Scottish Museum is held in official quarters, that the annual report of this important adjunct to the education of young and old in Scotland should not be regarded as worthy of printing. The typewritten copies are unimpressive in appearance, awkward in size, and are unlikely to be stored away, as annual reports of this kind should be, for comparison with their predecessors in tracing the development of the Museum.

THE national museums of Great Britain have still to formulate a serious policy for the encouragement of children, and while they hesitate or, as in the Royal Scottish Museum, make somewhat feeble and tentative efforts, it is informative to glance at another example of the progress made in the United States. A section of the Annual Report for 1928–29 of the Peabody Museum of Yale University is devoted to the Children's Department. A staff of three ladies is set aside by the Museum authorities for this work and an entire house has been acquired for the Department's use. The result is that on an average four classes a day from the schools in New Haven have been entertained and informed in the Museum. Of the 65 public schools, 55 have visited the institution for lectures or tours. In all, 455 groups have had the services of one or more *docents* in the Museum during the year, and in addition one of the staff has spoken to 130 classes in the city schools. It is a record which will bear abundant fruit in the interest which the children will take in the Museum and its collections in later years.

CONSIDERING the large number of waterfalls there are in Africa, it is at first sight strange that the total hydroelectric power generated there scarcely amounts to the output of a first-class steam power station. When it is remembered, however, that there is little demand for power near any of the big falls, and that there are great seasonal and year-to-year variations in the flow of water, which would necessitate the construction of large and costly reservoirs, it will be seen that at present there is no great scope for commercial hydroelectric power stations. In certain parts of Africa the high evaporation from reservoirs is a serious drawback. There are water power stations at Katanga and Northern Rhodesia in connexion with copper mining. In South Africa, where great commercial developments have taken place, there is an abundant supply of cheap and easily worked coal. The Witwatersrand goldfield, for example, has an excellent coal-field quite close to it. It is interesting to learn that the negotiations between the Tanganyika Government and the Power Securities Corporation for the development of the Pangani Falls have been satisfactorily concluded. The power developed at these falls is sufficient to provide the entire region of Tanganyika Territory between the Great Lakes and the Indian Ocean with electric power. The scheme appears to be a good one and cheap power would

stimulate agricultural and industrial development. There is a small station at Dar-es-Salaam which uses fuel carried long distances by sea, but it is incapable of coping with the demand.

A MOST important problem that electricians have to solve is to invent a device which will prevent the electric pressure between high pressure supply mains or between one of them and some other conductor from attaining such a value that a spark may ensue and the consequent arc cause a breakdown of the supply system. The sudden rise of pressure may be due to atmospheric electricity, lightning discharges, or impulsive rushes of electricity due to a sudden alteration of the load on the network. A great variety of lightning protective devices and electrical 'safety valves' are in use, but none is entirely successful. Most of them want constant attention, and some of them are objectionable to have in a power station owing to the liquids they contain. We are interested therefore to learn from a *Daily Science News Bulletin* recently issued by Science Service, Washington, D.C., that a new material called 'thyrite' has been discovered which is practically an insulator at low voltages but becomes a conductor when the pressure is high. The substance, we are told, includes carborundum, and a sample of it had a resistance of 50,000 ohms at 100 volts, and at 10,000 volts its resistance was half an ohm. The change in the resistance appears to take place gradually and not suddenly. It would therefore not be very useful as a safety valve between two high pressure mains. It might be very useful, however, in some form of lightning protector. Thyrite resembles black slate in colour and its mechanical properties are analogous to those of dry process porcelain. In manufacturing, the material can easily be moulded to the shape required. The contact surfaces are coated with metal by the Schoop metal spraying process.

A CURIOUS problem of bird-flotation was raised by F. H. Alexander at a meeting of the Challenger Society at Cullercoats on May 2 last. He found that the body of a bird, without feathers, has a specific gravity nearly equal to unity, but since a bird does not float without its feathers, such a statement has little practical bearing. He further stated, however, that the high freeboard with which most birds float is not easily accounted for, since actual measurements of the underwater volume of floating birds showed that they displaced a volume of water equal only to one-third or even one-quarter of their own weight. Various suggestions are made as to the powers which may aid ordinary displacement in supporting the bird—perhaps surface tension, perhaps special use of the internal air sacs, perhaps an unknown power of 'levitation'. Our own impression is that Mr. Alexander's data are faulty. Birds have the power of raising their feathers at will, and in water-birds, in which the feathers are kept well oiled, this means a large increase of volume impenetrable to water, in other words, a much greater displacement than would be suggested by measuring a dead or living bird in the hand. The only means of obtaining the displacement of a floating bird is by measuring the water displaced, and this simple check Mr. Alexander has not employed. Until that is known all speculation based upon calculations made upon a bird out of the water seems to us to be of little value.

MUCH has been heard of the alleged Maglemose harpoons found by the late Beaumont Morfitt at Skipsea and Hornsea. But surely their last appearance as genuine finds of the period claimed for them must be that in the *British Museum Quarterly* for April, where without a word of caution they are described as "mesolithic harpoons". The authenticity of the discoveries has always been doubtful. There should no longer be any doubt if the new evidence brought forward by Mr. T. Sheppard in *The Naturalist* for May is accepted. He states that a sister of the finder of the harpoons told him, in the presence of others, that her brother Beaumont made these harpoons from the leg bone of a red deer he had found in the peat, that he boiled them in glue, and invented the story of their discovery. It is to be regretted that this story was not submitted to the Committee which inquired into the authenticity of the weapons.

THE Society for Constructive Birth Control and Racial Progress founded a 'Mothers' Clinic' for the instruction of normally formed women in simple measures for the control of conception. An analysis of data from ten thousand cases attending this clinic, compiled by Dr. Marie Stopes, has been published. Of the 10,000 women attending, 9912 were married, 5 only were unmarried and already mothers, and 83 were betrothed couples about to be married. Among the cases, a considerable number desired the knowledge to enable them to space their later and desired children, and 142 childless women sought help towards securing pregnancy. Valuable data have been secured of the numbers of pregnancies, live children, and miscarriages that have occurred among these women. Cases with lacerations of the cervix uteri numbered 1321; this injury is prone to develop cancer, so that its early recognition and treatment are important.

THE Prime Minister has nominated Mr. J. H. Whitley, formerly Speaker of the House of Commons, to be chairman of the British Broadcasting Corporation in succession to Lord Clarendon, who recently resigned.

EARL BUXTON, from 1914 until 1920 High Commissioner and Governor-General for South Africa, has been awarded the African Society's Gold Medal. This medal is awarded from time to time to those who have rendered eminent services either for or in Africa. Lord Buxton has been for ten years president of the African Society.

SIR HENRY G. LYONS, has been reappointed Director and Secretary of the Science Museum, and will hold that office until October, 1933. Sir Henry was originally due to retire last October, on attaining the age of sixty-five, but was invited by the Board of Education to retain his post for a further year.

THE Huxley memorial lecture of the Imperial College of Science and Technology next year will be delivered by Sir A. Smith Woodward, on "Modern Progress in Vertebrate Palæontology," in the Royal College of Science, Exhibition Road, S.W.7, on Monday, May 4, 1931, at 5.30 P.M.

THE Albert medal of the Royal Society of Arts for the current year has been awarded by the Council, with the approval of the president, H.R.H. the Duke of Connaught, to Prof. Henry E. Armstrong, "for his discoveries in chemistry and his services to education". The medal was founded in 1863 as a memorial to Prince Albert, for eighteen years president of the Society, and is awarded each year "for distinguished merit in promoting Arts, Manufactures, and Commerce".

THE following appointments have recently been made by the Secretary of State for the Colonies: Mr. D. W. H. Baker, to be superintendent of agriculture, Nigeria; Mr. A. B. Harper, to be produce inspector, Nigeria; Mr. A. K. Gibbon, to be assistant conservator of forests, Nigeria.

THE Microscopical Society of Wales held its inaugural meeting at the Technical College, Cardiff, on June 4, when the following officers were appointed: *President*, Dr. H. A. Harris; *Vice-Presidents*, Dr. David Hepburn, Mr. Clarence A. Seyler; *Chairman*, Dr. James Beatty; *Secretary*, Mr. Alfred E. Harris; *Committee*, Mr. J. Malcolm Davies, Mr. Donald Hicks, Mr. W. T. Lane, Eileen Melville, Mr. E. A. Rudge, Mr. J. H. Wilson; *Treasurer*, Mr. L. Osborne Davis. The office of the Society is at 27 Park Place, Cardiff.

THE reviewer of "The Time-Journey of Dr. Barton," in NATURE of May 31, while sympathising with the prospective developments described, remarked that the work "does not face the real issue", that is, the manner in which individual rights, aims, and prejudices are to be co-ordinated for obviously desirable ends. Mr. John Hodgson, the editor of Dr. Barton's manuscript, writes to say that Chap. xxix. (entitled "The New Control") is devoted to the consideration of this vital point.

A PARAGRAPH in our "News and Views" columns of May 31 recorded a television performance given before an audience of 500 people in New York. The screen used was six feet square. A note from the Baird International Television, Ltd., 133 Long Acre, W.C.2, reminds us that television was projected upon a large screen in England so far back as December 1928, when Mr. Baird showed images on a screen 4 ft. by 4 ft. At present sight and sound are being broadcast daily by the British Broadcasting Corporation, and Great Britain is the only country in the world which has an official and regular service of broadcast sight and sound, and where 'televisors' are available to anyone who cares to purchase them.

THE Report of the Water Pollution Research Board for the year ended June 30, 1929, has been issued (Dept. Sci. Ind. Research. London: H.M. Stationery Office, 9*d*. net). It contains the report of the director of water pollution research with details of investigations on the purification of beet-sugar factories' effluent. It is believed that by a process of biological filtration more than 90 per cent purification of beet-sugar factory effluents can be effected.

WE have received catalogues of second-hand microscopes and accessories and of 'optical utilities' from Messrs. W. Watson and Sons, Ltd. (313 High Holborn, W.C.1). The former includes objectives having the exceptionally high N.A. of 1·5 and 1·6, also recent microscopes and accessories and books, the property of a distinguished microscopist. Among 'optical utilities', the 'window telescope', the 'Univis' bi- and tri-focal spectacle lenses, and the 'Speera binocular magnifiers are of interest.

THE causes of neo-natal death is the subject of a report by Dr. J. N. Cruickshank issued by the Medical Research Council (*Special Rep. Series*, No. 145. London: H.M. Stationery Office, 1*s*. 6*d*. net). In 800 cases of neo-natal death (that is, death of the infant between birth and the end of the fourth week) examined, the cause of death was considered to be birth asphyxia, birth injury, or prematurity in 540 cases, infective conditions in 238 cases, and gross developmental defects in 22 cases. Asphyxia at birth is thus an important cause of neo-natal death, and Dr. Cruickshank devotes a section of his report to a consideration of recent advances in the treatment of the condition.

THE Ministry of Health has issued an eighth report of the Advisory Committee on the Welfare of the Blind, 1928–29 (London: H.M. Stationery Office. 6*d*. net). The total registered blind population of England and Wales in 1929 is 52,727, as compared with 46,822 in 1927 and 30,785 in 1920, being ratios to the general population of 1 : 749, 1 : 835, and 1 : 1219 respectively. It is considered that this apparent increase is mainly due to better registration and not to an actual increase of blindness. Juvenile blindness (0-5 years) has not increased but has remained almost uniform during the last five years. The bulk of the increased number of blind persons is accounted for by the increase among those above fifty years of age, and it is suggested that there is a fruitful field for inquiry into the whole question of the care and preservation of the sight of the adult population.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Forest officers and estate officers, each on probation, under the Forestry Commissioners—The Secretary, Forestry Commission, 22 Grosvenor Gardens, S.W.1 (June 16). A radium custodian for the Hull Radium Trust—The Chairman, Hull Radium Trust, Royal Infirmary, Hull (June 17). A woman assistant in the Agricultural Department of the Surrey Agricultural Committee, to work under the small livestock instructress, and an assistant instructor in agriculture in the Agricultural Department of the Surrey Agricultural Committee—The County Agricultural Officer, Agricultural Department, County Hall, Kingston-on-Thames (June 18). A lecturer in electrical engineering at the Dudley Technical College—The Director of Education, Education Offices, Dudley (June 19). An

assistant lecturer in geography in the University of Durham.—The Secretary of Council, University Offices, North Bailey, Durham (June 20). A lecturer for biology, general science, and hygiene at the Kenton Lodge Training College for Women, Newcastle-upon Tyne.—The Director of Education, Northumberland Road, Newcastle-upon-Tyne (June 21). A teacher of mechanical engineering subjects at the Technical College, Wolverton.—The Principal, Technical College, Wolverton, Bucks (June 23). A head of the Building Department of the Birmingham Central Technical College.—The Principal, Central Technical College, Suffolk Street, Birmingham (June 25) An assistant lecturer in mathematics at the Brighton Technical College.—The Secretary, Brighton Education Committee, 54 Old Steine, Brighton (June 28). A lecturer in electrical engineering, and an assistant lecturer in mechanical engineering, at the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (June 28). A technological chemist under the Ceylon Coconut Research Scheme, for work on the chemistry of the coconut and its commercial products.—The Agricultural Adviser to the Secretary of State for the Colonies, 2 Richmond Terrace, Whitehall, S.W.1 (June 30). A lecturer in mathematics at the Northampton Polytechnic Institute.—The Principal, Northampton Polytechnic Institute, St. John Street, E.C.1. (June 30). An assistant Government analyst for Hong Kong.—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (June 30). Junior assistants at the National Physical Laboratory — The Director, National Physical Laboratory, Teddington (June 30). Three research fellowships at the Onderstepoort Veterinary Research Laboratory, Pretoria, respectively for work on tissue culture and filterable viruses, bacteriology, and the physiology of animals, especially ruminants, and the extraction of toxic substances from plants and the determination of the nature of such substances—The Secretary, Empire Marketing Board, 2 Queen Anne's Gate Buildings, S.W.1 (Sept. 1). A junior assistant chemist under the Research Association of British Flour Millers—The Director of the Association, Old London Road, St. Albans. Teachers for evening classes in physics, heat, light, and sound advanced; photography; building construction, geometry, and graphics for building students; calculations for builders; building science; and for plaster work, at the Woolwich Polytechnic—The Principal, Woolwich Polytechnic, S.E.18. A laboratory assistant in the Research Department, Woolwich—The Superintendent, Research Department, Woolwich, S.E.18.

Our Astronomical Column.

Absolute Motions of Stars.—*Astr. Nach.* No. 5696–5697 contains a catalogue of the absolute velocities of 1937 stars, by R. Klumak and F. Hecht. The radial velocities are taken from J. Voute's Second Catalogue of Radial Velocities (Lembang Observatory, 1928). The solar motion is assumed as 19·7 km./sec. towards R.A. 270°, N. Decl. 30° 28′ (1900). This is taken out of the stellar motions, which are therefore absolute as being referred to the mean of the stars in the neighbourhood of the sun. But the general motion of these stars round the galactic centre is not considered. The parallaxes have been slightly modified where necessary, to make them accord with the adopted absolute magnitudes of the stars. The proper motions in R.A. and Declination are then reduced to km./sec. and combined with the radial velocities. The resultant velocities are tabulated and the Right Ascension and Declination of the points to which they are directed. The catalogue contains a number of stars of abnormally high velocity, as these have naturally attracted the special attention of observers.

Work of the Naval Observatory, Washington.—Volume 12 of the publications of this Observatory is mainly occupied with equatorial observations of various objects; there are series of observations of the satellites of Mars and Saturn, and discussions of them for the improvement of their orbit elements. Numerous comets and minor planets were observed; their positions are given from 1908 to 1926. The photo-heliographic observations of sunspots extend from January 1917 to the end of 1927.

The determination by wireless signals of the difference of longitude between Washington and San Diego, California, which was made in the autumn of 1926, as part of the international series of longitude determinations, is described in detail. The observatory also controlled the sending of the wireless signals from Annapolis and Bellevue, near Washington, and made arrangements for those sent from Honolulu. Small transit instruments were used; they were placed in the open air. The transits were all made by the travelling-wire method; this practically eliminates personal equation, so that interchange of observers is not necessary. The amount of this equation was, however, determined by personal equation machines, and applied to the results of each observer. The resulting difference of longitude between Washington and Paris is 5 hr. 17 min. 36·665 sec. with a probable error of only 0·002 sec.; it is 0·013 sec. greater than the value obtained in 1913–14, also by wireless, but receiving the signals by ear. None of the determinations in the series has a greater error than 0·003 sec.; it will be remembered that in pre-wireless days the difference between the English and French determinations of the longitude Paris-Greenwich went into the first decimal.

Spectroscopic Study of ξ Ursae Majoris.—Mr. Louis Berman investigates this system in *Publ. Ast. Soc. Pacific* for February. The star is a well-known visual binary with a period of 60 years, and both the components are spectroscopic binaries. The brighter component has the long period (for spectroscopic binaries) of 669·18 days; that of the fainter star is determined by Mr. Berman as 3·9805 days. Only one spectrum is visible, so the ratio of masses cannot be determined. The eccentricity of the orbit is very small, and it has been treated as circular; $a \sin i$ is equal to 275,860 km. The parallax 0·131″ is derived from the combination of the radial velocities of the components A, B. This is in good accord with the value 0·123″ adopted from direct measures. It is noted that the stars A B will be so close to each other until about 1940, that it will be impossible to obtain separate spectrograms of the two components; Mr. Berman therefore considers this a suitable time to summarise our knowledge of this interesting system. The spectroscopic observations determine which of the two possible positions of the plane of the visual orbit is the correct one.

Research Items.

Dental Morphology of Prehistoric Guam.—A collection of crania obtained by Dr. J. C. Thompson and Mr. H. G. Hornbostel in 1922 from Guam, one of the Mariana Islands in Micronesia, and now in the Bernice P. Bishop Museum of Honolulu, has been examined by Dr. R. W. Leigh, who publishes his results in vol. 11, No. 3, of the Museum's *Memoirs*. The crania are of pre-Spanish or early post-Spanish origin and belong to a homogeneous group which was probably inbred. The ancient Chamorros, as the inhabitants are called, lived exclusively on the fauna and flora of the island, a fact of importance in relation to the pathology of the teeth. Early navigators said they did not eat meat of any kind, though they had fowls and kept doves in captivity. Nor were they cannibals. They chewed betel but did not make use of fermented beverages. The teeth are well formed, the average dental index being 42·6, the group tending to the mesodont. Five per cent evidence slight developmental disturbance. Ethnic deformation was practised to a limited extent by filing on the facial surface of the six superior anterior teeth. Staining the teeth orange to black was customary. Owing to betel chewing there was a permanent discoloration of the enamel and a predisposition to degeneration of the investing dental tissues. The lime used produced enormous accretions on the teeth. Owing to the habit of chewing and the soft character of the food, there was a high incidence of periodontoclasia, the chronic destructive degeneration of the investing tissues of the teeth which eventuates in exfoliation. This was the major cause of the loss of teeth in later life, but no person deceased before thirty years of age had lost any teeth ; 18 per cent showed dental caries.

Destruction of Rats by Red-Squill Powders.—An ideal poison for rats must be effective, safe to use, and cheap. The ordinary rat posions (strychnine, arsenic, phosphorus, and barium carbonate) are dangerous not only to domestic and wild animals, but also to human beings, and the U.S. Department of Agriculture has carried through tests with powders made from squill (*Urginea maritima*) (U.S. Dept. Agr., *Tech. Bull.*, No. 134). The results confirm E. G. Boulenger's work at the London Zoo, and the advice given in the British Ministry of Agriculture and Fisheries leaflet on the destruction of rats. It was found that red-squill powder is toxic to rats, while white squill is not. Cats, dogs, chickens, and pigeons are not seriously harmed by squill powders, since food so poisoned is either refused or, if eaten, is promptly vomited. Powders prepared by directly drying unfermented, sliced red squill bulbs in an oven at 80° C. are usually more toxic than those prepared in any other way, the lethal dose being about 250 milligrams per kilogram of body weight for white rats, and rather less for wild brown rats. Variation in toxicity makes it desirable that squill powders should be tested before being marketed, and adjusted to a standard, 10 grams of 10 per cent squill bait to kill a minimum of 1 kilogram of rat.

Blood of the Eel.—Mr. Nobuyuki Kawamoto contributes two papers to the fourth number of vol. 4 of the *Science Reports of the Tôhoku Imperial University* (Fourth Series (Biology), Sendai, Japan. December 1929. "Physiological Studies on the Eel. I. The Seasonal Variation of the Blood Constituents. II. The Influence of Temperature and of the Relative Volumes of the Red Corpuscles and Plasma upon the Hæmoglobin Dissociation Curve"). In both researches the common eel, *Anguilla japonica*, was used. It was found that the relative volume, number of corpuscles, viscosity, and iron content increase as soon as hibernation begins and decrease as it approaches its end, but, on the other hand, the non-protein nitrogen is much less at that time and increases in summer with the rise of temperature and period of growth. In the second paper it is shown that the hydrogen ion concentration of the blood was constant during 43 days of starvation. The oxygen capacity is directly proportional to the relative volume of red corpuscles, the volume varying much in the eel. Less oxygen is taken up by the blood when the temperature becomes higher, thus agreeing with previous work on other animals. The author concludes from the greater amount of heat produced during chemical reaction between oxygen and hæmoglobin that the blood of the eel possesses greater affinity for oxygen than that of the frog or man.

Differentiation of Sex.—In a summary article on the differentiation of sex in vertebrates, Dr. Rogers Brambell (*Sci. Progress*, April 1930) begins by accepting the sex chromosomes as a primary mechanism of sex determination firmly established, and then goes on to point out that while they are normally the decisive factors, yet other equally potent factors are at work. The fact that in *Drosophila* super-males and super-females as well as intersexes are produced when there is a lack of balance between the number of *X*-chromosomes and the number of sets of autosomes shows that the latter play their part in determining sex. By crossing different geographical races of the gypsy moth (*Lymantria dispar*), Goldschmidt has obtained intersexes which led finally to the hypothesis that the Mendelian sex factors are quantitative, that racial variations occur in them, and that a time factor in their expression during development is also involved. It has long been known that the sex ratios of frogs in some localities are abnormal, and subsequent research has shown that some males develop testes directly, while in others they arise from transformed ovaries. The frequency of these two types of males differs in various localities. Witschi has shown by crossing hermaphrodites that the male frog is heterogametic (*X Y*), and it appears that the indirect form of development depends upon a delay in the time at which the male-determining stimulus becomes effective. Environmental factors as well as the time element, also play a part. Intersexes in pigs, the inheritance of which has been studied, and of the histology of which Brambell describes a case, again involves a time factor as well as quantitative sex differences, the ovotestes of pigs being accounted for by the abnormally late appearance of the male-determining stimulus.

Development of *Callichthys*.—Miss Frances M. Ballantyne in a paper entitled "Notes on the Development of *Callichthys littoralis*" (*Trans. Roy. Soc. Edinburgh*, vol. 56, part 2 (No. 18), 1930), describes in detail the embryonic development of this very interesting South American siluroid. An unusually complete series of eggs and embryos collected by Dr. G. S. Carter on his expedition to the Gran Chaco was available for this study. *Callichthys* makes a nest of leaves, and the eggs are carefully guarded by both male and female until the tadpole-like young are hatched. The process of segmentation is like *Salmo*. The embryo is far advanced when it emerges from the egg. Gill breathing is helped by the intestine, the caudal and dorsal fins probably taking part, especially in the early stages when they are very

vascular. In development it resembles the Dipnoi in certain points, in others it is like *Polypterus*. In many ways it is a typical teleost. The paper is very well illustrated by clear diagrams in the text and by plates representing the various embryonic stages with reconstruction of the chondrocranium.

Chromosome Linkage in *Œnothera*. — An important paper on meiosis in *Œnothera* has been published by Mr. D. G. Catcheside (*Trans. Roy. Soc. Edinb.*, vol. 56, No. 19), who has made a study of *Œ. pycnocarpa*, *Œ. nutans* ($2n = 14$) and a triploid mutation of *pycnocarpa*. He shows that in all three the chromosomes are arranged end to end in a closed ring. Ishikawa, in a study of embryo sacs and fertilisation, found a case of dispermy in a hybrid between *Œ. pycnocarpa* and *Œ. nutans*, and the triploid *pycnocarpa* (with 21 chromosomes) is regarded as probably arising in this way, through the union of two male nuclei with the egg nucleus. The fact that its chromosomes are in a closed ring of 21 is opposed to the hypothesis of parasynapsis in *Œnothera*. On the heterotypic spindle in the triploid the chromosomes take up the zigzag arrangement characteristic of *Œnothera*, but always with irregularities. Later, they separate usually 10-11, thus confirming an early account of Gates for triploid Œnotheras. In the triploid, one of the three sets of chromosomes must be present in duplicate, and yet there are no free pairs of chromosomes. This appears to upset the hypothesis that ring formation is contingent upon a heterozygous condition of the chromosome complement. Catcheside supports the view that chromosome linkage is inherited as a genetic character determined by one or more genetic factors. He shows that this hypothesis is in accord with the numerous cases of linkage thus far described.

Proteolysis in Plants.—Botanists will welcome warmly a brief restatement of his experimental investigations of the proteases of plants and of his conclusions therefrom, which Prof. S. H. Vines has been moved to prepare (London: Macmillan and Co., Ltd., 1930) as the result of making acquaintance with the rather different views on protein digestion by enzymes that have been advanced of recent years by Prof. Willstätter and his collaborators. In these later papers the different behaviour of different plant extracts to the protein substrate has been traced to the different activation in the different solutions of the same enzyme system, so that in one case it may attack fibrin, in another peptone, whilst the production of amino-acids, such as tryptophane, during digestion was attributed to the decomposition of peptides by a peptidase. Vines, on the other hand, thought that he had given good experimental grounds for the separation from some plant extracts of two enzyme systems, a peptase attacking proteins such as fibrin and an ereptase attacking peptone, producing from it amino-acids including tryptophane. Vines restates succinctly the experimental grounds which led him to the conclusion; the paper is a very clear summary of his series of papers in a difficult field and is of value as putting the two alternative points of view clearly in contrast.

Cretaceous Mollusca of South Africa.—The species of *Trigonia*, which were so numerous and widely distributed in Mesozoic times, were divided by Agassiz into eight sections, to which three others have been added by later workers. Following the present tendency to divide large genera into smaller groups, Dr. E. C. N. van Hoepen (*Palæont. Navors. Nas. Mus. Bloemfontein*, **1**, 1; 1929) has proposed nine new genera for the species of *Trigonia* found in the chalk of Zululand. Further and prolonged study of the species in other formations and countries is needed before the phylogenetic significance of these genera can be regarded as established. J. V. L. Rennie, in a paper on the Cretaceous fossils from Angola (*Ann. S. African Mus.*, **28**, 1; 1929), describes a number of new lamellibranchs and gasteropods from the Albian and Senonian, and points out the close relationship of the Senonian forms to those found in Pondoland and Zululand. In another memoir the same author (*ibid.* **28**, 159; 1930) enlarges our knowledge of the molluscan fauna of the Senonian of Pondoland.

Rotary Oil-Well Drilling Plant.—The rotary system of drilling oil-wells is now so well known and so securely established in practically all the oilfields of the world, that it would seem almost superfluous to describe other than revolutionary features. But the last year or two has witnessed some of the most striking engineering feats in oilfield development that are on record, more particularly in connexion with deep holes, carried actually to depths of nearly 10,000 feet. Since the rotary system of drilling has been responsible for such achievements, it is only natural that the recent modifications and developments of this time-honoured plant should receive notice, and in Mr. Neils Matheson's paper, read before the Institution of Petroleum Technologists on April 8, he did full justice to the means by which such results have been achieved. The author described some of the latest types of drilling machinery designed to procure both deep and straight holes, the latter of almost equal importance to the former from a geological point of view. Among the alterations noted are the increase of the size of the drilling rig to 136 feet (100 feet was considered quite a fair average only a few years ago); increase in derrick-floor space to 26 feet, and replacement of standard 'band-' and 'calf-wheels' by secondary 'draw-works'. In other directions an important advance is made by replacing cast iron by 'electric steel', that is, cast iron made from 30-100 per cent steel scrap, and generally strengthening all materials employed both in plant and superstructure. Labour-saving devices are lavishly introduced and the problem of safety of the drillers—often conspicuously neglected in extra-American oilfields—has received expert attention. The evolution of the rotary oil-well drilling plant clearly has not come to a standstill, and as the demand for accurate rather than speedy drilling is increased, so we may expect a correspondingly high standard in design and efficiency of this extremely adaptable means of producing petroleum.

High Voltage Electrometer.—In the issue of the *Physikalische Zeitschrift* for April 1, Prof. T. Leodor Wulf of the College of Falkenburg describes a new filament electrometer which can be used for the measurement of high voltages. About 2 cm. of Wollaston wire is mounted vertically about 0·2 cm. in front of a vertical strip of metal and the wire is kept stretched by quartz springs at its ends. The strip and wire are mounted in a metal case from which they are insulated by a sulphur plug. A metal sphere 6 cm. in diameter projects into the case and its centre may be placed at any point on a perpendicular to the strip through the centre of the filament. When the voltage to be measured is applied to the sphere, the filament is charged by induction and is attracted towards the sphere. The motion of the centre of the wire is dead beat and is observed through a microscope from the side. When the filament and strip are connected to the case, the instrument will measure up to 50,000 volts. When filament and strip are insulated from the case and the voltage is applied

directly to them, the instrument will read down to 1 volt. The instrument can be arranged for photographic reproduction of the motion of the filament, and several photographs are given in the paper.

A Simple Transmission Dynamometer.—In *Engineering* for May 16, Messrs. E. Giffen and C. M. White describe a new form of transmission dynamometer which has been in use for the last six months in the Engineering Laboratory of King's College, London. Dynamometers for the measurement of the power consumption of any machine are generally of the torsionmeter type, depending for their action upon the twisting of a shaft. Such apparatus has to be delicate, needs careful handling, and requires considerable space. The dynamometer described was designed to overcome these disadvantages, and tests of the instrument show that it is robust, fool-proof, compact, and accurate. In this apparatus power is transmitted by a spur wheel on the driving shaft to a spur wheel on a lay shaft. This lay shaft also carries a sprocket wheel over which runs a chain, driving a sprocket wheel on this driven shaft. The gear is enclosed in an aluminium case carrying ball-bearings, and an extension of this case forms the torque arm, on the extremity of which weights can be placed. Designed to transmit 10 h.p. at 2000 r.p.m., the dynamometer was tested by a comparison with a friction brake of the band type, and the results are given by a series of curves included in the article, which also gives illustrations of the apparatus.

Direction Finding by Radio.—Mr. R. H. Barfield read a paper on April 2 to the Institution of Electrical Engineers (Wireless Section) on recent developments of direction-finding apparatus. This paper describes the results obtained when carrying out part of the programme of work mapped out by the Radio Research Board. It is well known that direction-finding apparatus of the closed loop type determines only the horizontal magnetic field of the radio waves. To get over this difficulty, Adcock devised a receiving system of spaced vertical aerials. This system, modified so as to produce a balanced effect, has been tested over a long period. It was calibrated by means of a transmitter attached to a kite which sent waves at a known downcoming angle and with known polarisation. The results prove that the flatness of the minima obtained with direction-finding apparatus at distances exceeding twenty miles was undoubtedly due to downcoming waves. Direction finding is possible on a wave-length of 24 metres up to a distance of 70 miles in the daytime and 30 miles at night in the summer season. Up to a distance of 20 miles the bearings are sharp and accurate to within 2° provided a good open site is found. A site which is clear of obstables to a hundred yards in all directions would be very suitable. At distances greater than 20 miles the minima are not nearly so sharply defined. At greater distances than 500 miles, the Adcock system gives indications of bearings within about 5°, but the loop direction finder is practically useless. The former system is much less affected by errors due to downcoming waves. At close ranges where the downcoming radiation is weak, the loop direction finder is to be preferred as it is more compact, robust, and portable.

The Decomposition of Nitrogen Pentoxide.—The rate of decomposition of nitrogen pentoxide has recently been the subject of a number of investigations and the results are somewhat divergent. In the April number of the *Journal of the American Chemical Society* there are two papers by Eyring and Daniels in which the rate of decomposition in inert and in chemically active solvents, respectively, is discussed on the basis of new experiments. In the inert solvents the decomposition was found to be strictly unimolecular, and the small differences in velocity caused by a change of concentration (from 0·1 to 1·8 molar) or of solvent, are thought to preclude the possibility that the reaction is complicated by traces of catalysts. The value of $1/2s$, where s is given by the equation $k = se^{-E/RT}$, is thought to represent, to a first approximation, the time taken for two atoms or groups at a valency bond to separate after activation, that is, the natural vibration period in the valency bond which is to break. It is predicted that s will approach an approximate constant in nearly all unimolecular reactions. In the case of chemically active solvents (nitric acid, propylene chloride, carbon disulphide, acetone, iodine) the results are specific and their interpretation is difficult, although solvation appears to play some part.

Fabrics Research.—We have received the second report of the Fabrics Co-ordinating Research Committee (Department of Scientific and Industrial Research; London: H.M. Stationery Office, 1930, 5*s*. net) which contains detailed reports on the fireproofing of fabrics, the action of sunlight on cotton, the waterproofness of 'porous' waterproof fabrics, the tensile test of fabrics, and the deterioration of fabrics by micro-organisms. The first report was published in 1925. The introduction to the report, written by the chairman of the committee, Dr. R. H. Pickard, gives a useful summary of the contents of the volume, from which it is evident that research work of great thoroughness and value has been carried out. The individual sections contain many tables and curves, and full bibliographies. That on fireproofing, in particular, is of very wide interest, and is probably the best guide on the subject in existence. Important results were obtained with borax and boric acid mixtures. The mixture was found to be much more effective than either substance separately. In the section on the effect of sunlight on cotton, use was made of the known fact that cotton after oxidation yields solutions in cuprammonium possessing a lower viscosity than similar solutions of the original fibre. The action of sunlight in the presence of air is probably an oxidation process similar to that due to chlorine. All the reports have important practical bearings, and the volume is one which will prove valuable in many aspects.

Thermal Data on Organic Compounds.—The April number of the *Journal of the American Chemical Society* contains a paper by Huffman, Parkes, and Daniels, giving the results of experiments on the specific heats and latent heats of fusion of a number of aromatic hydrocarbons. The entropies have in some cases been calculated from these data, and found to agree with the equation $S_{298} = 25{\cdot}0 + 7{\cdot}7n - 4{\cdot}5r + 19{\cdot}5p$, where n is the total number of carbon atoms outside the benzene ring, p the number of phenyl groups in the compound, and r the number of methyl branches attached on the main aliphatic chain of the molecule. A similar equation had been found to hold for liquid paraffins: $S_{298} = 25{\cdot}0 + 7{\cdot}7n - 4{\cdot}5r$, where n is the number of carbon atoms in the molecule and r the number of methyl branches on the side chain. The free energies are also calculated, and ortho-, meta-, and para-isomers are considered to have practically identical free energies of formation. The free energy of hydrogenation of benzene to form cyclohexane was calculated in two different ways, the results being in agreement. The work was undertaken at the instance of the American Petroleum Institute.

South-Eastern Union of Scientific Societies.

CONGRESS AT PORTSMOUTH.

THE thirty-fifth annual Congress of the South-Eastern Union was held at Portsmouth on May 28–31, at the invitation of the Lord Mayor and the City Corporation, the Portsmouth Literary and Philosophical Society, and the Portsmouth Geological and Archæological Society, with Mr. O. G. S. Crawford in the presidential chair in succession to Sir Arthur Keith.

The meetings were held in the Municipal College and in the Guildhall, where the city plate were exhibited and explained by Mr. J. Hutt, the Chief Librarian. In the Congress museum, held in the room of the Portsmouth Gas Company, many local objects were shown, the most striking being the prehistoric relics exhumed by Col. J. H. Cooke from burials on the Portsdown Ridgeway, notably amongst them being a fine flint dagger of Solutré, a type found with the bones of a bronze age warrior of great stature. An unusually interesting perambulation of Old Portsmouth was conducted by Mr. R. Pook, who had prepared a booklet for the occasion.

The president, who is the well-known Archæology Officer of the Ordnance Survey and the editor and founder of *Antiquity*, took as the title of his address, "What is Archæology?" He finds that few really realise what archæology is, and many papers written on the subject are really history, but there is a period of about a thousand years after Caesar's invasion in which the two overlap. Anthropology, being the study of man, may deal with both history and archæology. There is history of which but for the archæologist we should never have heard. Such is, for example, the Minoan civilisation of Crete, and although we have a dim reflection in the Iliad and the Odyssey of an early civilisation, we should have known but little of it but for the discoveries of Schlieman. Archæology is a method of reconstructing the past, so far as man is concerned in it, and it replaces or supplements history. Archæology is a hobby, but the student of it does not always do the actual digging, as he often has to give lectures in order to raise the money for his work. Mr. Crawford emphasised the point that the æsthetic preserver of ancient structures must exercise moderation in his desire, since all that is ancient is not always beautiful and worth preserving. Age and beauty are not necessarily associated. The march of progress cannot be withstood, and the love of old things because they are old is in practice an attitude impossible to maintain. We must adapt ourselves to modern developments. The practical policy is to endeavour to preserve certain large areas of uncontaminated countryside as national playgrounds, so that in days to come our descendants may know what England once looked like. A few uninhabited tracts so preserved would amply compensate for the loss of a few ruins or antiquities, the preservation of which may be found to be impossible.

In field work Mr. Crawford finds Great Britain supreme, whilst in the new science of air archæology it is not only supreme: it stands alone. An eloquent plea was made for the accurate naming of specimens, and also for the placing in a local museum of isolated finds that are often lost through being retained in private hands. When Mr. Crawford was excavating in the Sudan, one of his best workmen was a retired cannibal. He had a lively imagination, but it was grounded in the hard school of life and fact. He would have been an active if unconventional fellow of the Society of Antiquaries. It is none too easy to reconstruct the conditions of prehistoric society, and almost impossible without some experience of a kindred society now functioning. Prehistoric man's attitude to life was a severely practical one; he was fundamentally lazy, and he never did things that he would consider useless to himself. The older archæologists were obsessed with the idea that ancient man was always at warfare, and forgot that the quest for food came first. The struggle for existence was a real one, and warfare as a means in the struggle would have been useless unless there were loot to be got. The face of England is a palimpsest. The pattern in which it is laid out is the result of a long process of evolution. The old patterns have to be traced under the new. We are only now beginning to realise what immense possibilities underlie the latest development of archæology, that of air-photography.

In the Archæological Section a paper by Prof. L. S. Palmer revealed some striking correlations between the pre-history of Hampshire and Africa. Like other travellers, Prof. Palmer was struck by the consistency of the evolutionary forms of the flint artefacts with those that have been established in European countries and found that Hampshire was no exception. Much attention was given to the Raised Beach terraces and the Coombe Rock overlying them in the coastal plain extending from southern Hampshire eastward into Sussex, and, following a paper by Col. J. H. Cooke, excursions to view these formations *in situ* were carried out. Near Westbourne Common a gravel pit revealed a series of pipes eating into an extensive mass of pounded and reconstructed chalk which here represents the Coombe Rock. It is hoped that the Raised Beach will eventually be found below it. M. L'Abbe Breuil was a distinguished visitor amongst the party. In the Coombe Rock of Emsworth Woods many split pebbles of distinct Blackheath Pebble Bed type were found, with the usual jasper-like colour and with the pounded surface markings. How they came here remains a problem.

In the Botanical Section Col. Wolley-Dod's "Experiences of a Field Botanist" proved extremely interesting, and the report of the work of the Section showed that considerable progress has been made in the botanical survey of Sussex, which was commenced at Hastings in 1927 under the ægis of Dr. A. B. Rendle. Ashdown Forest is now particularly under examination, and a beginning has been made of the western area.

In the Zoological Section Mr. John F. Marshall gave an account of the important work that is being done at the Mosquite Control Institute established by him at Hayling Island, and revealed to many this little-known organisation of a great national service. A record of intensive research work was given by Miss G. F. Selwood in her paper on "Fauna Changes in a Bog at Bembridge".

In the Regional Survey Section Mr. D. Halton Thompson gave an account of the sources of the water-supply of Portsmouth, and showed that most of the water came from the folded chalk, and little from the syncline in which the older Eocene beds lie north of Portsdown. Mr. G. E. Hutchings showed "Some Applications of Regional Survey in Education", and Mr. A. Farquharson gave the results of "A Regional Survey of Chichester".

Geologists and botanists concluded their visit to Portsmouth with an excursion to Whitecliffe Bay, Isle of Wight, where both branches of parties found much to record in the tertiary clays, sands, and limestones of that interesting spot.

Members of the Congress attended a reception given by the Lord Mayor in the spacious Guildhall, and received every assistance and welcome from their hosts the municipal authorities.

Leeds Meeting of the Institution of Gas Engineers.

THE Institution of Gas Engineers met in Leeds for its annual meeting on June 2–6, under the presidency of Mr. C. S. Shapley, manager of the Leeds Gas Department. Several of the papers dealt with questions of actuality in the world of carbonisation.

Mr. E. G. Stewart examined the "Functions of Coke Ovens" in a paper of great interest in view of the recent issue of the report of the Area Gas Supply Committee. His analysis revealed that only about four British gas undertakings are large enough to consider the installation of such plant, although a group of smaller undertakings might do so. The coke ovens should rationally be attached to iron and steel works, which need the gas as fuel. If that were generally the case, there would be no coke oven gas to spare. As gas-making plant, the coke oven is not superior to the modern vertical retort, which is more flexible. The development of coking plants increases the pressure on the coke market, which will be intensified if the gas works purchase spare gas. This points to the need for an understanding between the two industries for the marketing of both main and by-products.

The need for greater freedom in constructing the tariffs for the sale of gas was emphasised so that differential prices might be charged according to the incidence of the load. Indeed, the freedom to rationalise the charging for gas was advanced on all sides as an essential preliminary to rationalising the supply of industrial gaseous fuel.

Dr. E. W. Smith summarised the experience gained in the process of dehydrating coal gas before distribution. This is a notable innovation introduced into practice by a British firm in 1925. By washing the gas with a strong solution of calcium chloride (glycerine has also been proposed) about two-thirds of the water normally present in coal gas is removed. The principal advantage is that the dew point of the gas is so far reduced that liquid water is never deposited in the mains and consequently corrosion of mains and meter, etc., is almost entirely prevented. Stoppages due to water and ice are avoided in winter, and many other advantages accrue, so that plants for the purpose are being erected with great rapidity and the practice is being adopted in foreign works.

Mr. F. Prentice described three years' experience with a waterless gasholder, of which a few already exist in Great Britain. The first was erected about fifteen years ago in Germany, where these holders are now numerous—indeed they are probably the most characteristic feature of the landscape in the Ruhr valley. The normal gasholder consists of a bell floating in water, but these consist essentially of a vertical cylinder closed by a piston, which rises and falls as the volume of gas in the holder changes. The piston is made gas-tight either by a tar seal or a grease joint at its periphery where sliding contact is made with the walls. Hailed at first as a piece of crazy engineering foredoomed to failure, a few years have falsified practically all of the prophecies, and many more will be seen in the future. The Ipswich holder, which is 202 ft. high, is only a small one and the large examples are undoubtedly wonderful engineering constructions.

A paper by Mr. C. F. Broadhead of Melbourne dealt with the production of a new road binder—bitural. The paper has a bearing on the problem of current importance to all carbonising industries. There is an over-production of tar, with consequent difficulty in marketing in the face of mineral road-making materials—bitumen and oil pitch. It is said that the tar from modern vertical retorts is not so good a road-making material as the old tar. Mr. Broadhead attributes this to the large proportion of unsaturated hydrocarbons in vertical retort tar, and proposes to polymerise these by air oxidation in the presence of an accelerator which induces condensation of the unsaturated hydrocarbons with phenols to form larger molecular aggregations. The tar is substantially altered in chemical character, and is said to have given satisfactory results in Australia as a road-making material.

The paper by Messrs. W. H. Hoffert and G. Claxton on benzole recovery in gasworks practice discussed the important question as to whether it is worth while to remove benzole from town's gas for use as motor spirit. It has generally been assumed that it was not, and relatively little is so obtained. The view is being challenged as the result of faulty costing, and the gas works will probably become much more prominent in this direction. The refining of benzole involves a loss of good fuel which has long been recognised as a challenge to the inventive. The authors detailed their method of adding to the crude spirit suitable anti-oxidant inhibitors to prevent the formation of objectionable gums which result from the polymerisation of unsaturated hydrocarbons—essentially an oxidation process. This is an interesting piece of chemistry which promises to be of great practical importance to the motor spirit industry.

Dr. Margaret Fishenden's paper was a collation of methods for handling heat transmission calculations. In particular she gave the results of the application of the principle of similarity to correlate the results of measurements of convection, showing that the observations of different workers could be closely harmonised in this way.

Prof. J. W. Cobb gave an account of the relations between the Institution of Gas Engineers and the University of Leeds extending back to 1906. The Institution lent encouragement to the establishment of a Fuel Department at the outset, and in 1910 endowed the chair in memory of the late Sir George Livesey. Since that time there has been close co-operation in the prosecution of investigations bearing on the problems of the industry. This is one of the earliest examples of co-operative industrial research in Great Britain, and the paper collated a large range of subjects which have been covered since that time. On the teaching side, it was stated that for years the demand for suitable graduates has been in excess of the men coming forward. H. J. H.

Visitation of the Royal Observatory, Greenwich.

THE annual visitation of the Observatory took place on June 7. The Astronomer-Royal presented his report, which deals with the work of the Observatory during the year ended on May 10. The usual fundamental meridian work was carried on with the transit circle, the sun having been observed on 150 days, and the moon on 104 days. The excess of the moon's longitude over its tabular value was 5·2″; the excess has been diminishing since 1924 by nearly ½″ per annum; the corresponding excess for the sun, which was 1·7″ in 1926, has now fallen to 1·6″. The observation of stars in the zone 32° to 64° of declination will be completed this year. The next star catalogue will cover the zones 0° to 24°, and 64° to 90°;

it is not now considered necessary to observe many stars fainter than magnitude 8 on the meridian; the positions of fainter stars are obtainable by photography with lenses of wide angle.

Observations with the Cookson floating zenith telescope now cover a period of nineteen years, which is the period of the great lunar nutation term. Dr. J. Jackson is discussing the observations, to deduce a new value for the coefficient of this term; it appears that the adopted value 9·210″ will not be altered by more than 0·002″. The Gerrish drive, installed last year on the 28-inch equatorial, has worked very well. 300 binaries were observed during the year, of which 56 were separated by less than ½″.

The determination of stellar parallaxes by photography with the Thompson equatorial has proceeded at an accelerated pace, 1508 parallax plates having been taken, and 651 plates measured.

The determination of the 'colour-temperatures' of stars has been continued with the 30-inch reflector. The observation of 24 stars selected as standards has been completed; these are now available as a base to which other stars can be referred. The absolute temperatures of the standards are now being found by comparison with an arc lamp, which in turn will be compared with a gas-filled lamp already calibrated at Utrecht.

The astrographic equatorial, which had been sent to Siam for the solar eclipse, was remounted in July. Some renewals in the bearings and accessories were satisfactorily carried out by Messrs. Grubb, Parsons and Co. The Greenwich astrographic zone, decl. 64° to 90°, is being re-photographed for the determination of proper motions by comparison with the earlier plates; the motions of 14,500 stars between 64° and 72° have now been published.

The sun was photographed on 270 days at Greenwich; plates taken at the Cape and Kodaikanal will render the record complete. The spot activity is definitely on the wane; there were, however, large spots in November and December. A spectrohelioscope has been lent to the Observatory by the Mount Wilson Observatory; it has been mounted in the south attic of the new building. A survey of the sun's disc in H_a light is made daily, when weather permits. Special attention is paid to the radial velocities of dark markings near sunspots.

Spot numbers for the whole disc, and for the central zone, are supplied regularly to Zurich for incorporation in the bulletin that is issued there under the auspices of the I.A.U.

The mean temperature of the year was 51·0°, which is 1·5° above the 75-year average; the extreme values were 90·5° on Aug. 31, and 25·4° on Mar. 20; both dates are unusually late for the extreme readings. The rainfall was 25·43 inches, which is 1·19 in. above the average. The winter was a stormy one, and the mean daily air movement, 289 miles, is 5 miles above the average. The highest daily value was 847 miles on Dec. 7; the highest hourly value 62 miles on Jan. 12, which also had the greatest pressure, 38 lb. per sq. ft.

The following are the mean values of the magnetic elements for 1929, obtained at Abinger; Decl. 12° 35·8′ W.; Hor. Force 0·18555: Vert. Force 0·42918: Dip 66° 37·2′. It is noted in the report that a more precise instrument for determining the vertical force and dip was lent by the National Physical Laboratory; it revealed a small systematic error in the values given by the dip inductor; the error was 0·00010 in Vert. Force, 0·3′ in Dip.

The performance of the Shortt clocks continues to be satisfactory; in the sidereal clock No. 3 an invar bob was substituted for the type-metal one; the latter contained lead, and a certain amount of settling appears to have gone on, causing an increase of losing rate. This increase still goes on with the new bob, but at only half the former rate.

Rhythmic time signals from the Observatory are distributed by the wireless station at Rugby at 10 h. and 18 h. These, and the signals sent to the Post Office and the B.B.C., are controlled by the clock Shortt No. 16.

The following are the mean amounts by which the time signals from other stations are late on Greenwich: Paris 0·044 sec.: Nauen 0·006 sec.: Annapolis (near Washington) 0·007 sec.: Bordeaux 0·035 sec. These are after corrections for lag and time of travel have been applied. A. C. D. CROMMELIN.

An Early Letter from Darwin to Owen.

THE letter printed below was bought at Sotheby's in March of this year for the Fitzwilliam Museum, Cambridge, by some friends of that institution. It was written rather more than two months after Darwin's return in the *Beagle*. The fossil vertebrates referred to in the letter were sent to the Royal College of Surgeons. Darwin wrote to Owen, who was five years his senior, as a young man addressing a more experienced and older colleague: later the two became friends and Owen visited Down in 1848. Twelve years later, in a letter to de Quatrefages, Darwin wrote: "I have been atrociously abused by my religious countrymen; but as I live an independent life in the country, it does not in the least hurt me in any way, except indeed when the abuse comes from an old friend like Professor Owen, who abuses me and then advances the doctrine that all birds are probably descended from one parent" ("More Letters of Charles Darwin", vol. 1, p. 202). Reference is made to Darwin's attitude towards Owen in a note printed at the head of a letter to Hugh Falconer (1863) on page 226 of vol. 2 of "More Letters".

Darwin settled at Cambridge on Dec. 10, 1836: he was at first a guest in the home of the Henslows, and later went into lodgings at a house in Fitzwilliam Street, on which a tablet has been fixed. The letter was written as from Christ's College, though he was presumably not actually in residence there.

A. C. S.

Decemb 19th (1836)

My dear Sir,

I have just written and will send it the same time with this, a letter to Sir Ant: Carlisle. I have done exactly as you recommended me. I thought myself compelled to fix on the British Museum in preference to that of Paris because I was carried on board a King's Ship; and the public collection of the country certainly has claims on me. If the collection had been made entirely at my own expense, that is on board a Merchant vessel, then I should not have hesitated in making a different choice. I quite agree with you that the British Museum ought to make returns when it has the power. I suppose you could not venture to propose another set for Paris. Their value would be so much more in that collection than in the British Museum. I ought to make up my mind to give my own set to Paris; but I confess I should be grieved to lose my trophies. I should feel like a knight who had lost his armorial bearings. If the Council should not choose to go to the expense necessary for making all the casts; it was suggested to me here, that the

College might pay the price of forming the casts, and the public bodies purchase the models, but I think you will agree with me, that if this can be avoided, it will be better. With respect to great head of the Rodent, I certainly feel inclined to run the risk of taking a cast, because the models will be more generally useful, even in case the head itself should be injured or destroyed. But I am sure after the kind and effectual manner with which you have entered on this affair I cannot do better than follow your advice. I, at one time, began to think that the fossil bones would be as troublesome to me and as of little service as some other branches of my collection are likely to be. But now I look back to the trouble I took in procuring them with great satisfaction. I do assure you I feel very grateful to you for having given me such good assistance. I have scarcely begun to unpack my cases ; in the course of a week I shall have every thing open, and I already know of one very large bone (of a Mastodon ??) which I will forward to the College. When separating the animals in spirits, I will put by any that I think will interest you. And it will be a great pleasure to me if I chance to possess anything which will be of use to you in your numberless investigations.

Believe me, my dear Sir,

Your very truly obliged
CHAS. DARWIN.

Christ Coll :
Cambridge.

To Richard Owen, Esq^{r}
Royal College of Surgeons,
Lincoln's Inn Fields.

Biochemical Studies of Spike Disease of Sandal.

MR. M. SREENIVASAYA and Mr. B. N. Sastri have continued their very detailed investigations into the spike disease of sandal (*Santalum album* L), and their latest results are to be found in the *Journal of the Indian Institute of Science*, vol. 12A, Part 17, pp. 233 to 252 (1929). Leaf-juice from a sandal tree infected with the spike disease hydrolyses more soluble starch than does the corresponding healthy juice. This is due to a higher concentration of the enzyme and to the presence of activators such as phosphates and amino acids. The *p*H of spiked leaves is lower than that of healthy leaves, and approaches the optimum for diastatic activity. More potato starch is, however, liquefied by the healthy leaf extract than by the diseased extract for equal weights of sugar produced, thus suggesting a qualitative difference between the two diastase extracts. It should be remembered that Dr. L. C. Coleman found that there was lower diastatic activity in spiked leaves than in healthy leaves, and therefore the results here reported might be interpreted as showing that the diastase content of diseased tissue fluctuates within the same limits as does that of healthy tissue.

The chemical composition of leaf and stem tissue fluids has also been investigated. The spike-diseased leaf contains more nitrogen, maltose, and reducing sugars and less ash (particularly calcium) than the healthy leaf. The stem fluids of spike-diseased trees are richer in nitrogen, phosphorus, and calcium than those of healthy plants, and there is a steep gradient of calcium concentration between the stem and leaves.

The seasonal variations in composition of healthy and partially spiked leaves of the sandal tree have been studied by Mr. A. V. Varadaraja Iyengar (*Jour. Ind. Inst. Sci.*, vol. 12A, Part 20, pp. 295-305). Season was found to affect the chemical composition of the leaves of both healthy and spiked plants in the same manner. The following relative differences were observable in all seasons—the diseased sap had less dissolved matter, less osmotic pressure, a greater electrical conductivity, more moisture, ash, and nitrogen contents, less calcium, and was more acid than healthy sap.

These detailed studies on sandal spike from the Indian Institute of Science have considerable significance, for it has recently been shown by Mr. M. J. Narasimhan (*Phytopathology*, **18**, pp. 815-817 ; 1928) that inclusion bodies similar to those which characterise certain virus diseases are present in leaf tissues of spiked plants. This, along with the work of Dr. L. C. Coleman on transmission, suggests that the malady is caused by a virus. We have thus a mine of detailed information on the chemistry of a diseased host which we can use in the elucidation of the problem of the nature of a plant virus.

University and Educational Intelligence.

ABERYSTWYTH.—Dr. C. D. Forde, formerly of the Department of Geography, University College, London, has been appointed to succeed Prof. H. J. Fleure in the chair of geography and anthropology at the University College of Wales, Aberystwyth. Dr. Forde has just returned from the University of California, where he held a fellowship from the Commonwealth Fund, and received the degree of doctor of philosophy for his researches among the Hopi Pueblo Indians of North Arizona.

CAMBRIDGE.—The following have been appointed members of the Committee for the Natural Sciences Tripos for the year 1930–31 : Prof. A. Hutchinson (chairman), Prof. T. M. Lowry, Mr. H. Thirkill, Dr. W. H. Mills, Mr. A. Wood, Mr. E. Cunningham, Mr. F. T. Brooks, Mr. T. C. Nicholas, Mr. J. T. Saunders, Dr. Dean, Sir Frederick Gowland Hopkins, Prof. J. Barcroft.

The General Board recommends that a University demonstratorship in pharmacology be established in the Faculty of Medicine.

Mr. Stanley Baldwin was installed as Chancellor of the University on June 5 and in the course of his address announced that the gift from the Rockefeller Foundation had been made available through the completion of the collection of a sum which was made a condition of the grant. The total sum required for the University Library and for research work was £1,179,000. The Rockefeller Foundation had promised £700,000 conditional on the balance being raised by the end of 1931. This balance has now been raised.

Honorary degrees were conferred by Mr. Baldwin after his installation on the following, among others : Prof. A. Einstein, of Berlin ; Prof. Max Planck, of Berlin ; Sir John Rose Bradford, president of the Royal College of Physicians ; and Sir James Colquhoun Irvine, principal and vice-chancellor of the University of St. Andrews.

LIVERPOOL.—Among the honorary degrees conferred on June 5 were the following : Doctor of Laws, Mr. R. L. Mond, honorary secretary to the Davy-Faraday Research Laboratory of the Royal Institution ; Doctor of Science, Prof. G. Barger, professor of chemistry in relation to medicine in the University of Edinburgh.

LONDON.—Applications are invited for the Graham Scholarship in Pathology, value £300 per annum, in the first instance for two years, founded under the

will of the late Dr. Charles Graham to enable "a young man to continue his pathological researches and at the same time to secure his services to the School of Advanced Medical Studies connected with University College Hospital as a Teacher under the direction of the Professor of Pathology".

The latest date for the receipt of applications is June 17. They should be sent to the Principal, University of London, South Kensington, S.W.7.

OXFORD.—The question of the destiny of the Radcliffe Observatory site and buildings has now come officially before the University in the form of a decree in Congregation. By this it is proposed to accept the offer of Sir William Morris, the purchaser of the site from the Radcliffe Trustees, to vest the whole of the property in the hands of a body of trustees, in order that it may be used for the benefit of the Radcliffe Infirmary and the Medical School of the University. The terms of the trust provide that the old observatory building shall be used for the purpose of medical teaching and research, and that the observer's house and garden shall be used as a residence for the director of the institute of research to be constituted in accordance with these terms.

The report issued by the Curators of the Botanic Garden includes a list of noteworthy plants lately received, and mentions improvements in the labelling of trees, shrubs, and plants.

The Herbert Spencer Lecture, delivered by Sir Peter Chalmers Mitchell, was a vigorous defence of materialistic monism, which, he said, so far from being discredited as a theory by recent advances in physical science, stands now in an even stronger position than in Spencer's day. Not one of the forms of what is called vitalism can, in his opinion, stand the test of critical examination. Progress in science must be achieved, as of old, by the way of experiment and observation.

In a lecture recently delivered in Oxford, Miss Caton-Thompson gave an interesting account of her exploration of the Great Zimbabwe and of other ruins in Rhodesia. She dwelt upon the fact that no evidence of any kind exists to suggest that these remains are of other than Bantu origin, or that they owe anything to outside influence. The stratigraphical evidence which is now available from many sites in Rhodesia all points in the direction of Bantu as against Arab, Phœnician, or any other kind of foreign activity.

THE New York correspondent of the *Times* states that Mr. Louis Bamberger, the retired head of Bamberger and Co., Newark, New Jersey, and his sister, Mrs. Felix Fuld, have given £1,000,000 for the establishment in Newark or the vicinity of an institute for advanced study, exclusively for post-graduate work and scientific research.

AT a meeting at the Mansion House, London, on June 2, the Lord Mayor presiding, it was announced that a contract had been signed for the purchase of a freehold site in Bloomsbury for 'London House', the proposed hall of residence in London for British male students of European origin from the Dominions and Colonies and from Great Britain. The object of the meeting was to launch an appeal for a fund of £250,000 to be administered by the Dominion Students' Hall Trust, for which an influential council of governors has been appointed, with Mr. F. C. Goodenough, of Barclay's Bank, as chairman. Towards this fund £130,000 has already been contributed. The appeal was supported from the platform by Mr. L. S. Amery, Mr. H. A. L. Fisher, Mr. Stanley Bruce, Sir James Parr, Sir William Clark, Sir Drummond Chaplin, Lord Moynihan, and Mr. F. C. Goodenough. Special reference was made to the post-graduate medical school to be established at Hammersmith. 'London House', while closely associated with the University of London, will be an independent institution and the governing body includes representatives of the University, the Royal Colleges of Surgeons and Physicians, and other professional institutions. The Corporation of the City of London and the Rhodes Trustees have each made a donation of £5000 to the fund. The Lord Mayor read a letter from the Prime Minister strongly supporting the appeal. "London House", he said, "appeals to common sense, to the spirit of hospitality, to the imagination. Let us look ahead and see the young men of our race coming to London with their vigour and freshness of outlook, intermingling with us and each other, sharing in our heritage of learning and experience and tradition, and returning so equipped to wherever British energy and enterprise have set their homes."

THE Committee of Award for the Commonwealth Fund Fellowships has made appointments to 26 fellowships tenable by British graduates in American universities for the two years beginning September next, including the following: Mr. R. W. Adams (Belfast) to Massachusetts Institute of Technology, in electrical engineering; Mr. J. T. Calvert (Oxford) to the Massachusetts Institute of Technology, in sanitary engineering; Miss I. G. M. Campbell (St. Andrews) to Cornell University, in organic chemistry; Miss R. L. Cohen (Cambridge) to Stanford University, in agricultural economics; Mr. A. G. Emslie (Aberdeen) to Cornell University, in physics; Mr. H. Fisher (London) to the Massachusetts Institute of Technology, in civil engineering; Mr. G. V. B. Herford (Oxford and London) to the University of Minnesota, in zoology; Dr. D. W. Hill (Bristol and Liverpool) to the University of Illinois, in biochemistry; Mr. F. L. Hudson (Manchester) to the University of California, in physical chemistry; Dr. J. Irving (St. Andrews and Cambridge) to Harvard University, in geology; Mr. T. H. Kelly (Birmingham) to Columbia University, in economics; Mr. J. E. MacColl (Oxford) to the University of Chicago, in economics; Mr. J. E. Meade (Oxford) to Stanford University, in economics; Mr. A. K. Nuttall (Cambridge) to Stanford University, in electrical engineering; Dr. R. W. B. Pearse (London) to the California Institute of Technology, in physics; Mr. R. W. Revans (London and Cambridge) to the University of Michigan, in physics; Mr. W. J. Sartain (Cambridge) to Yale University, in economics; Mr. W. A. Sinclair (Edinburgh and Oxford) to Harvard University, in philosophy; Mr. S. Steele (Cambridge) to Johns Hopkins University, in aero engineering; Mr. William Wild (Leeds) to the University of California, in physical chemistry. The following have been appointed to fellowships tenable by candidates from the British Dominions: Mr. N. S. Bayliss (Melbourne and Oxford) to the University of California, in chemistry; Mr. W. G. K. Duncan (Sydney and London) to the University of Chicago, in sociology; Mr. P. J. Hogan (Dublin and London) to Iowa State University, in civil engineering; Mr. S. J. Pretorius (Stellenbosch and London) to Cornell University, in economic statistics. The following have been appointed to fellowships tenable by candidates holding appointments in Government service overseas: Dr. C. M. Tattam, of the Geological Survey of Nigeria; Mr. C. Vigne, of the Forestry Department, Gold Coast Colony; Capt. R. D. Waghorn, of the Indian State Railways.

Historic Natural Events.

June 15, 1818. Avalanche Flood.—An avalanche from the front of the glacier of Lépenaz blocked the outlet of the Lake Glière, raising its level 25 feet. When the dam broke a mass of water estimated as one hundred million cubic feet in volume flooded the valley of Doron of Champigny, carrying away all the bridges but one.

June 15, 1829. Hailstorm.—At Cazorla, in the south-east of Spain, hailstones fell in the form of blocks of ice, some of which had a circumference of 20 in. and weighed as much as 4½ lb. Great damage was done, houses being literally crushed beneath the bombardment of ice.

June 15, 1896. Japanese Earthquake Sea-waves.—A great earthquake occurred off the north-eastern coast of Japan, its epicentre being 150 miles from land at a depth of 4000 fathoms (4½ miles) near the foot of the western slope of the Tuscaroora Deep. The shock was slightly felt on land, but after a lapse of 21 minutes great sea-waves, more than 60 feet in height, swept over the coast and caused the loss of 27,000 lives. The sea-waves were recorded at Honolulu (3591 miles) and Sausalito (San Francisco Bay, 4787 miles).

June 15, 1914. Severe Thunderstorm over Paris.—On June 15, 1914, a severe thunderstorm occurred over Paris. During the storm 2·1 in. (54 mm.) of rain fell, 1·6 in. (41 mm.) within twenty-five minutes. On only one other occasion has this been equalled. The heavy rain caused the subsidence of several streets.

June 16, 1819. Indian Earthquake.—The great earthquake of Kutch, in the delta of the Indus, disturbed an area of more than 3 million sq. miles. A large tract of land, 2000 sq. miles in area, subsided, and the sea, flowing in by the eastern mouth of the Indus, submerged the village of Sindree and converted the tract into a lagoon. A short distance to the north, the previously level plain was raised as an elevated mound, 50 miles long and about 10 feet in height, running east and west or parallel to the line of subsidence.

June 17, 1815. Thunderstorms.—There were heavy thunderstorms in Belgium on June 17, which made the roads difficult for traffic. As a result the movements of the French army, which were timed for the early morning of June 18, were delayed until nearly noon. This loss of time may have affected the course of the battle of Waterloo.

June 18, 1764. Thunderstorm in London.—During a violent thunderstorm the steeples of St. Bride's in London and the church at South Weald in Essex were both struck by lightning and much damaged. At St. Bride's the metal spindle carrying the vane was fixed into a stone, and the greatest damage was done at this junction, the stone being shattered into small pieces. H.M.S. *Ramillies*, lying at Chatham, was split and torn to pieces by the lightning at about the same time. It is noted that the preceding weather had been very warm and dry, and that the damage was done before the rain began to fall. The storm is of interest for the discussion which it provoked at the Royal Society, and because it helped to bring about the use of lightning conductors in Great Britain.

June 18, 1907. Waterspout.—A phenomenon variously described as a 'cloudburst' or 'waterspout' occurred near Blanchland on the eastern edge of the Durham Moors. A dense column, shaped like two cones joined at their apices, approached very rapidly, with a noise like the engine of a heavy motor-car. Near the village it burst, and an immense volume of water fell from it, flooding the whole countryside, while heavy rain and hail added to the damage. Large stone walls were broken up and their contents scattered over the fields, while the roads were seriously damaged and in places entirely destroyed. Eight sheep were killed by lightning, while others were washed away and drowned.

June 19, 1566. Floods in Europe.—From June 19 onwards for a whole month there was serious flooding by the Rhine. There were also great floods in the Danube, Drau, and Save. In England, after a very rainy spring, the summer was dry and the autumn almost rainless.

Societies and Academies.

LONDON.

Linnean Society, May 1.—**E. B. Worthington**: Vertical movements of fresh-water macroplankton. The changes in vertical distribution of Crustacea were examined over periods of twenty-four hours or more in the Victoria Nyanza and in Lake Lucerne by means of a vertically hauled closing plankton-net. The movements of the plankton were traced from hour to hour and correlated with the amount of light and other physical conditions. In L. Lucerne, most species start their descent at dawn, and reach their lowest level (50-60 metres) before the sun attains its zenith. Then a slow upward movement starts, accelerates at dusk, and continues for two or three hours after complete darkness. There is a difference between the behaviour of young and old individuals of certain species. The organisms appear to be under the influence of two forces: (1) a negative geotropism, acting persistently from below and causing them to congregate in the upper layers, and (2) a negative heliotropism, acting intermittently from above and causing those species which are susceptible to light to descend during the day. Most species are filter-feeders, dependent on the nanno-plankton, which is most abundant in the upper layers; it is suggested, therefore, that hunger is the ulterior reason why they should seek the upper layers.—**G. P. Bidder**: On the attitude of a Hexactinellid at the bottom of the sea, as compared with that assumed in museum jars and monographs. Glass-sponges have never been seen in the great depths which form their natural habitat; they are known only from specimens torn up from the bottom of the ocean. The dermal tissue of sponges is sensitive to the movement of water over its surface. If we assume that in growing sponges growth is more rapid on the side against which the current impinges, we can explain the anomalies of spoon-like and fan-like forms in the same species of Clionid or Axinellid sponges in which cup-like forms are found, the cup-like form showing a compassing tide and the fan a constant current. A similar reaction in a sponge of fixedly tubular shape would cause the side of the tube towards the current to grow longer than the sheltered side, so that the sponge would bend until the axis of the tube lay down-stream and all sides were acted upon equally.—**M. Burton**: Glass-sponges. The scientific history of sponges can be resolved into three phases: (1) prior to 1842, when opinion was divided whether they were plant or animal; (2) from 1842 until recent years, when they were regarded as animals, but their position was doubtful; (3), 1929, marked by Dr. Bidder's proposal to revive the idea of treating them as a sub-kingdom, the Parazoa. This sub-kingdom he divided into two phyla, the Nuda and the Gelatinosa, the former to include the Hexactinellida only, the latter the rest of the sponges. This recognition of the great gulf between the Hexactinellida and other sponges, and between sponges and the rest of the animal kingdom, counteracts the tendency

to make too close a comparison between the Hexactinellida and other sponges, and it also lays stress on the undesirability of seeking to homologise the structure of sponges with that of the Metazoa.

CAMBRIDGE.

Philosophical Society, May 19.—Dr. P. A. M. Dirac: (1) On the annihilation of electrons and protons. On the basis of the relativity wave equation for the electron, a calculation is made of the probability per unit time of an electron jumping into a state of negative kinetic energy and emitting the surplus energy in the form of two light-quanta. If we assume that nearly all the negative-energy states are occupied by electrons and that an unoccupied one is a proton, this probability gives the rate at which electrons and protons annihilate one another. The calculated rate is much too large to be in agreement with observation.—(2) Note on exchange phenomena in the Thomas atom. The equations of the self-consistent field with inclusion of exchange effects may be expressed in terms of a single total electron density function. If we approximate to this density by considering it as a classical function of commuting co-ordinates and momenta, we get the equations of the Thomas atom with an extra term representing the exchange effects.

EDINBURGH.

Royal Society, May 16.—Georg Weigner: Base exchange. The difficulties experienced by Way and other early investigators in explaining the mechanism of exchange processes are gradually being overcome by intensive study of reactions in colloid systems. Cation exchange properties are attributed to micelles consisting of an ultramicron, an inner layer of anions, and an outer swarm of cations; only the ions of the outer swarm are exchangeable, and the extent of the reaction depends upon their hydration, valency, and the forces binding them to the inner layer. For example, magnesium, on account of its greater hydration, is absorbed less readily than the other alkaline earths; but it is not so easily displaced, because it forms less soluble compounds with the hydroxyl ions of the inner layer. The ultramicron of clays and permutites may contain silicic acid and aluminium hydroxide; within certain limits, the greater the proportion of the former the greater the cation exchange. That is because there is a greater dissociation of cations from the silicic anions than from the hydroxyl ions attached to the aluminium. Ionic exchange determines the potential and coagulation of the particles.

PARIS.

Academy of Sciences, April 28.—Ernest Esclangon: The determination of the position and of the elements of a planet or distant comet. Application to the Lowell celestial body.—Gabriel Bertrand and Mme. M. Rosenblatt: The proportion of potassium and sodium contained in plants which grow in brackish water or on the sea-coast. The analysis of sixteen species of plants is given. All the plants contained both potassium and sodium, with a general predominance, sometimes considerable, of potassium. It is only in plants adapted to media rich in common salt that the ratio K/Na falls below unity.—A. Th. Schloesing and Désiré Leroux: The solvent action of carbonic acid with respect to phosphoric acid in agricultural soils.—André Blondel: Falls of electromotive force in triphase apparatus feeding unsymmetrical circuits.—Henri Villat and Maurice Roy: Concerning the problem of Saint-Venant for the slit cylinder. Reply to some remarks by A. Mesnager.—S. Finikoff: W congruences having along corresponding radii the same linear complex operator.—Georges Bouligand. Certain classes of surface of three dimensional Euclidian space.—Henri Cartan: The exceptional values of a meromorph function in the whole plane.—Elie Cartan: The third fundamental theorem of Lie.—Marcel Dufour: The astigmatism of the pencil refracted by a spherical diopter.—P. Swings: The resonance groups of the diatomic vapour of sulphur.—Maurice Piettre: The function of the non-electrolytes in the stability of biological media. If electrolytes play an important part in the equilibrium of organic liquids, this rôle is restrained within certain limits. Lipides have a very remarkable influence the physico-chemical mechanism of which is still unexplained.—M. Paić: Study of the system $HgO.SO_3.H_2O$. A combination of analytical and X-ray methods.—A. Travers and Avenet. The estimation of the total cyanogen in effluents from coke ovens. The essential point is treatment of the well-cooled solution with sodium peroxide before acidifying and distilling off the hydrocyanic acid.—Sébastien Sabetay: The optically active acidylhydrazides and their use for the separation into optical isomers of the racemic aldehydes and ketones.—J. Bougault and Mlle. L. Popovici: The reduction of the semicarbazones and thiosemicarbazones of the α-ketonic acids and of the sulphoxytriazines.—Raymond Chevallier: The permanent magnetisation of the Feroe basalts.—H. L. Parker: The polyembryonic development of *Macrocentrus gifuensis*.—Raymond Hovasse: Some new data on the cochineal insect, *Marchalina hellenica*.—Ugo Lumbroso: New researches on the etiology of trachoma. The study of a germ, met with in Tunis, in its relations with the *Bacterium granulosum* of Noguchi.

GENEVA.

Society of Physics and Natural History, Mar. 6.—R. Wavre: The force which, at earlier periods, tended to draw a continent to the equator. The author gives an extremely simple formula for calculating the intensity of the force which causes a floating body, boat, iceberg, or continent to increase its distance from the pole. This force is proportional to the square of the velocity with which the earth turns round its axis. This velocity has been reduced in the course of geological epochs owing to the phenomenon of tides. The force in question was much greater then than now.—G. Tiercy: A formula giving the value of the colour index of a star. This deals with the question of obtaining a new approximation of the solution of the problem, retaining terms the influence of which has hitherto been neglected in the calculation.—E. Rod: Tables of the coefficients of the instrumental errors, in Mayer's formula, for the latitude of Geneva. These new tables have been worked out for declinations from $-31°$ to $+80°$. The values are given for every degree from $-31°$ to $+30°$, every $30''$ from $+30°$ to $+35°$, every $20''$ from $+35°$ to $+69°$, and every $10''$ from $+69°$ to $+80°$.

Mar. 20.—L. Duparc: An anorthose trachyte from Gambeila (Abyssinia). The author has collected in small volcanic cones a rock of a particular type, formed almost exclusively of microlites of anorthose. The rock is very rich in alkali (nearly 15 per cent).—J. Briquet: The glochide trichomes of Helminthia. The author shows that, contrary to that which has been recently proved for the glochide emergence of Crupina, the multiseries glochides of Helminthia are of purely epidermal origin, without vascular elements, and their hoods are formed uniquely by the curvature of the apical cells of the foot. This puts the glochidate hairs, from the functional point of view, in relation with a mode of zoochore dissemination.—E. Pittard: The coronal angle in the skulls of Bushmen, Hottentots, and Griquas. The author has measured a series of skulls sent to the anthropological laboratory of the University of Geneva by the Cape Town Museum. The values obtained compared with those of the

cephalic index indicate certain differences between the Hottentots and the Griquas.—**R. Wavre**: The planetary stratifications. The author gives a method for recognising whether a given family of surfaces can represent the stratification of a star in rotation. This method dispenses with the calculation of the potential. As a particular case, he arrives very simply at the theorems of Volterra and Dive on the impossibility of ellipsoidal stratifications.—**P. Balavoine**: The luminosity of some colouring matters in ultra-violet light. If wool or silk dyed with auramine is submitted to ultra-violet light, there is produced a strong yellow luminosity resembling phosphorescence. Fluorescine and its derivatives present the same phenomena, but with less intensity.

May 8.—**J. Carl**: Some observations on the relief of southern India. In the course of a journey made during the winter of 1926–27, having for its principal object studies of the fauna, the author also made observations on the relief of the country. He distinguishes three erosion cycles clearly visible on large-scale maps. His interpretations are in agreement with the evolution of relief of the island of Ceylon, described by F. D. Adams (*Canadian Journal of Research*, 1929).

PRAGUE.

Czech (Bohemian) Academy of Sciences and Arts (Second-class, Natural Science and Medicine), Feb. 7.—**L. Borovansky**: Morphological changes in rats effected by strenuous work.—**J. Charvat, A. Gjurič and E. Sedláčková**: The protein preparatory reflection.—**V. Jarnik**: Some remarks on the Hausdorff measure.—**V. Kladivo**: The determination of the relative intensity of gravity in Brno and Potsdam respectively.—**J. Basta**: The mechanical theory of the solidification and hardening of cements and concrete. It is concluded from experimental investigations that the chief physico-chemical laws determine the hardening of concrete and rational formulæ are derived for practical use.—**R. Nováček**: Biological factors in the formation of dolomites.—**F. Wald**: Principles of the theory of chemical operations.

Mar. 14.—**V. Kladivo**: The determination of the relative intensity of gravity in Brno and Vienna respectively.—**R. Brdička and M. Pavlík**: Automatic registration of extinction curves of absorption spectra. An apparatus has been constructed which makes possible the photography of continuous absorption spectra in solutions by using a Baly tube in which the thickness of the solution layer is automatically diminished logarithmically with time, whilst the dark slide is shifted with constant speed. A complete characteristic extinction curve is thus obtained in about 20 min.—**J. Hybl**: The heat of evaporation of liquids. The constants a, b, c were evaluated for twelve polyatomic liquids in the following expression for the heat of evaporation: $a(T_{cr}-T)-b(T_{cr}-T)^2+c(T_{cr}-T)^3$, where T_{cr} is the critical temperature.—**A. Vančura**: The function of factors outside the kidney in the origin of kidney and heart œdema.—**P. Sillinger**: The vegetation of the limestone hills of Tematínské Kopce (Western Slovakia). On the dolomites of this small group near Pišt'any the pennonic associations predominate, though the Carpathian element is not absent. Exhaustive description of all plant communities of this region is given.—**K. Domin**: *Draba fladnisensis* Wulf, a new species for Czechoslovakia. This alpine species was found in the Tatra of Biela. The author gives an analysis of the plant associations on the localities of this Draba, which represent an interesting glacial relic.—**F. Prantl**: Revision of Czech Devonian Fenestellidæ.—**J. Sobotka**: Generalisation of cyclographic and stereographic projection.

Official Publications Received.

BRITISH.

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1929. Pp. 18. (London: H.M. Stationery Office.) 6*d*. net.

Smoke and Health: a Lecture delivered at the Manchester College of Technology on November 15th, 1929. By Dr. J. S. Taylor. Pp. 12. (Manchester: National Smoke Abatement Society.) 2*d*.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1289 (Ae. 43s): The Determination of the Water Resistance of Seaplanes. By H. M. Garner and L. P. Coombes. (T. 2872.) Pp. 10+1 plate. 9*d*. net. No. 1293 (Ae. 442): Exploration of the Flow near the Screw proposed for the N.P.L. Compressed Air Tunnel. By C. N. H. Lock and A. R. Collar. (T. 2895.) Pp. 10+6 plates. 9*d*. net. (London: H.M. Stationery Office.)

Trinidad and Tobago. Minutes and Proceedings of the Froghopper Investigation Committee. Part 18. Pp. 80. (Trinidad: Government Printing Office, Port-of-Spain.)

Cambridge University Agricultural Society Magazine, 1930. Pp. 78. (Cambridge: W. Heffer and Sons, Ltd.) 2*s*. 6*d*.

The Welsh Journal of Agriculture: the Journal of the Welsh Agricultural Education Conference. Vol. 6, January. Pp. 367. (Cardiff: University of Wales Press Board.) 2*s*. 6*d*.

British Science Guild. The Annual Report of the Council of Management 1929–30, presented at the General Meeting of Members held at the Offices of the Guild on Thursday, 5th June 1930, at 4.30 P.M. Pp. 14. (London.) 1*s*.

Engineering Training at the Works of W. H. Allen, Sons & Co. Ltd., Bedford, England. Pp. 30+11 plates. (Bedford.)

Proceedings of the Royal Irish Academy. Vol. 39, Section B, No. 16: Some Geological Observations on the Origin of the Irish Fauna and Flora. By Prof. J. Kaye Charlesworth. Pp. 358-390. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1285 (M. 66): Mechanical Properties of Pure Magnesium and certain Magnesium Alloys in the Wrought Condition (continued). Mechanical Properties of "Electron" Alloy. By H. J. Tapsell, S. L. Archbutt and Dr. J. W. Jenkin. (A. 30.) Pp. 9+3 plates. 9*d*. net. No. 1275 (Ae. 421): The Interference of a Wind Tunnel on a Symmetrical Body. By C. N. H. Lock. (T. 2842.) Pp. 20+5 plates. 1*s*. net. No. 1281 (Ae. 427): "Cornering" at High Speeds. By W. C. Jennings. (T. 2862.) Pp. 9+7 plates. 9*d*. net. No. 1284 (Ae. 434): Pressure Plotting a Streamline Body with Tractor Airscrew Running. Part 2: Airscrew in Rear Position. By C. N. H. Lock and F. C. Johansen. (T. 2835.) Pp. 17+9 plates. 1*s*. net. No. 1291 (Ae. 440): Some Generalised Curves for the Accelerated Motion of an Aeroplane. By H. Glauert. (T. 2883.) Pp. 11+6 plates. 9*d*. net. No. 1295 (Ae. 444): Maximum Lift Coefficient of "Starling" with Clark YH Wings. By R. P. Alston. (T. 2886.) Pp. 2+2 plates. 3*d*. net. No. 1301 (Ae. 435): Experimental Comparison between a Series of Turns of Different Diameter on a Gloster IV Seaplane. By J. K. Hardy. (T. 2871 and a.) Pp. 6+4 plates. 6*d*. net. (London: H.M. Stationery Office.)

FOREIGN.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 4, No. 5, May. Pp. 601-735. (Washington, D.C.: Government Printing Office.) 40 cents.

Bernice P. Bishop Museum. Bulletin 67: Hawaiian Marine Algae. By Marie C. Neal. Pp. 84. 2 dollars. Bulletin 68: Geology of the Marquesas Islands. By Lawrence John Chubb. Pp. 71+3 plates. 2 dollars. Bulletin 69: Marquesan Legends. By E. S. Craighill Handy. (Bayard Dominick Expedition, Publication No. 18.) Pp. 138+1 plate. 2 dollars. Bulletin 70: Ethnology of Tubuai. By Robert T. Aitken. (Bayard Dominick Expedition, Publication No. 19.) Pp. iv+169+13 plates. 2 dollars. Bulletin 71: The Geology of Kauai and Niihau. By Norman E. A. Hinds. Pp. 103+12 plates. 2 dollars. Bulletin 72: Geology of Rarotonga and Atiu. By Patrick Marshall. Pp. 75+5 plates. 1 dollar. Bulletin 73: Remarks on Pacific Fishes. By Victor Pietschmann. Pp. 24+4 plates. Memoir, Vol. 11, No. 2: Growth of Children in Hawaii, based on Observations by Louis R. Sullivan. By Clark Wissler. (Bayard Dominick Expedition, Publication No. 17.) Pp. 151. Memoir, Vol. 11, No. 3: Dental Morphology and Pathology of Prehistoric Guam. By R. W. Leigh. Pp. 19+3 plates. 1 dollar. (Honolulu.)

Wisconsin Geological and Natural History Survey. Bulletin No. 46: Mineral Lands of part of Northwestern Wisconsin. By W. O. Hotchkiss and E. T. Bean, assisted by H. R. Aldrich. (Economic Series No. 21.) Pp. xiii+212. Bulletin 71: The Geology of the Gogebic Iron Range of Wisconsin. By H. R. Aldrich. (Economic Series No. 24.) Pp. x+279+16 plates. (Madison, Wis.)

Proceedings of the United States National Museum. Vol. 77, Art. 8: Synonymical and Descriptive Notes on Parasitic Hymenoptera. By A. B. Gahan. (No. 2831.) Pp. 12. Vol. 77, Art. 9: Three new Genera and five new Species of Parasitic Crustacea. By H. F. Nierstrasz and G. A. Brender à Brandis. (No. 2832.) Pp. 9. (Washington, D.C.: Government Printing Office.)

Meddelande från Lunds Astronomiska Observatorium. Ser. 2, Nr. 55: Statistical Investigation of the Coordinates, Magnitudes and Proper Motions in W. Gyllenberg's "Katalog von 11800 Sternen der Zone +35° bis +40° ag Lund". By Sture Holm. Pp. 88. (Lund: C. W. K. Gleerup; Leipzig: Otto Harrassowitz.)

Southwest Museum Papers. No. 3: The Tragedy of the Blackfoot. By Walter McClintock. Pp. 53. (Los Angeles.) 50 cents.

U.S. Department of Commerce: Coast and Geodetic Survey. Serial No. 166: Directions for Magnetic Measurements. By Daniel L. Hazard. Third edition. Pp. vi+129+8 plates. (Washington, D.C.: Government Printing Office.) 30 cents.

The Memoirs of the Imperial Marine Observatory, Kobe, Japan. Vol. 2, No. 4: On the Mean Atmospheric Pressure, Cloudiness and Sea Surface Temperature of the North Pacific Ocean. By K. Tsukuda. Pp. 163-202+39 plates. (Kobe.)

Memoirs of the College of Science, Kyoto Imperial University. Series B, Vol. 5, No. 1 (Articles 1-4), March. Pp. 88+4 plates. Series B, Vol. 5, No. 2 (Articles 5-11), March. Pp. 89-245+plates 5-17. (Tokyo and Kyoto: Maruzen Co., Ltd.)

U.S. Department of Commerce: Bureau of Standards. Research Paper No. 163: Reduction of Data on Mixture of Color Stimuli. By Deane B. Judd. Pp. 515-548. (Washington, D.C.: Government Printing Office.) 10 cents.

Bulletin of the School of Mines and Metallurgy, University of Missouri. Technical Series, Vol. 11, No. 1: The Scientific Fundamentals of Gravity Concentration. By Prof. Josef Finkey. Translated into German from the Hungarian by Prof. Johann Pocsubay. Translated from the German by C. O. Anderson and M. H. Griffiths. Pp. 295. (Rolla, Mo.) 1 dollar.

CATALOGUE.

Notes on the Hardness Testing of Metals. Pp. 16. (London: Wild-Barfield Electric Furnaces, Ltd.)

Diary of Societies.

FRIDAY, JUNE 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Annual General Meeting), at 5.—T. Thomas: An Experiment in Keratoplasty.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—E. J. Williams: (*a*) The Induction of Electromotive Forces in a Moving Liquid by a Magnetic Field, and their Application to the Investigation of the Flow of Liquids; (*b*) The Motion of a Liquid in an Enclosed Space.—Prof. E. V. Appleton: Wireless Methods of Investigating the Electrical Structure of the Upper Atmosphere.—Prof. C. R. Darling: A Simple Method of Showing the Modes of Vibration of a Wire.—Demonstration by Dr. H. R. Lang on A Modified Callendar Recorder for the Automatic Control of a High Temperature Oil Bath.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.—L. R. Cox: Description of a New *Vexillum* from the Pleistocene of the Farsan Islands (Red Sea).—Dr. B. Prashad: Observation on the *Trochus* and *Turbo* Fisheries of the Andaman Islands.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. H. Clay: Unemployment.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—N. Ashbridge: The History of Broadcasting in this Country.

SATURDAY, JUNE 14.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Eastern District Meeting) (at Richmond and Barnes) (at Town Hall, Richmond), at 12.

BIOCHEMICAL SOCIETY (in Department of Biochemistry, Oxford), at 2.30.—G. F. Marrian: Observations on the Chemical Nature of Crystalline Œstrin.—C. W. Carter: Observations on the Curative Factor for Heartb-lock in Pigeons.—E. Walker: The Alleged Presence of Bile Salts in Normal Blood.—H. J. Phelps: (*a*) Further Observations on the Mechanism of Adsorption of Weak Electrolytes by Charcoal; (*b*) Adsorption by Fuller's Earth.—J. R. P. O'Brien and G. L. Peskett: On the Concentration of Bios.—C. W. Carter, H. W. Kinnersley, and R. A. Peters: Factors Necessary for Maintenance Nutrition in Pigeons.—H. W. Kinnersley and R. A. Peters: Some Improvements in the Use of Phosphotungstic Acid in the Purification of Vitamin-B_1.—H. Chick and A. M. Copping: (*a*) The Stability of Vitamin-B_2 to Heat and Alkali; (*b*) A Search for 'Vitamin-B_3' in Yeast Extracts.—L. F. Hewitt: Oxidation-reduction Potentials of Cultures of *C. diphtheriæ* and of *Staphylococcus aureus*.—R. A. McCance and K. Madders: The Comparative Rates of Absorption of Sugars from the Human Intestine.—F. Dickens and F. Šimer: The Respiratory Quotient of Animal Tissues.—B. C. J. G. Knight: (*a*) The Oxidation-reduction Potential of Sterile Broth; (*b*) A Method of Poising the Oxidation-reduction Potential of Bacteriological Culture Media.—E. C. Dodds, A. Greenwood, H. Allan, and E. J. Gallimore: Observations on the Properties and Physiological Action of Comb-growth Promoting Substances (Testicular Hormone).—J. A. Cranston: Denitrification and Bacterial Growth Phases.—F. K. Herbert and M. C. Bourne: The Non-Sugar Substances of Human Blood in Anæmia and Polycythæmia.—H. J. Page and A. W. Greenhill: The Relation Between the Nitrogen- and the Phosphorus-contents of Grass.—*Demonstrations*:—V. B. Reader: Third Vitamin-B Factor in Rat Nutrition.—R. B. Fisher: Blood Pressure of Avitaminous Pigeons.

MONDAY, JUNE 16.

ROYAL SOCIETY, EDINBURGH, at 4.30.—Dr. G. C. Simpson: The Climate during the Pleistocene Period.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Sir Ambrose Fleming: Creation and Modern Cosmogony (Presidential Address).

TUESDAY, JUNE 17.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—R. W. Pethen: A Londoner's Memories of Bird Life.

WEDNESDAY, JUNE 18.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Western District Meeting) (at Town Hall, Torquay), at 2.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Dr. C. E. P. Brooks and S. T. A. Mirrlees: Irregularities in the Annual Variation of Temperature in London.—Dr. C. E. P. Brooks: The Climate of the First Half of the Eighteenth Century.

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 6.15.—Annual General Meeting.

FOLK-LORE SOCIETY (at University College), at 8.—M. Gaster: Roumanian Contes Devots.

THURSDAY, JUNE 19.

ROYAL SOCIETY, at 4.30.—*Papers probably to be read*:—Prof. H. R. Robinson and C. L. Young: New Results of the Magnetic Spectroscopy of X-Ray Electrons.—Dr. F. C. Toy and G. B. Harrison: Photo Conductance Phenomena in the Silver Halides and Latent Photographic Image.—C. H. M. Jenkins and M. L. V. Gayler: The Optical Determination of High Metallurgical Temperatures. The Melting Point of Iron.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—D. P. Dalzell: Note on Automorphic Functions.—T. Estermann: On the Representations of a Number as the Sum of Two Numbers not divisible by k-th Powers.—C. J. A. Evelyn: On the Frequency of Certain Numbers.—B. Kuttner and S. W. P. Steen: Divisor Functions. The Fourier-divisor Integral Theorem.—P. M. Owen: A Generalisation of Hilbert's Double Series Theorem.—R. E. A. C. Paley: Note on Power Series.—H. S. Ruse: Normal Covariant Derivatives.—J. A. Todd: On Questions of Reality for Certain Geometrical Loci.—E. M. Wright: The Bernstein Approximation Polynomials in the Complex Plane.

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.

CHEMICAL SOCIETY, at 8.—N. V. Sidgwick and L. E. Sutton: The Constitution of Some Organic Derivatives of Thallium.—F. G. Mann: The Constitution of Complex Metallic Salts.—Miss M. S. Lesslie and E. E. Turner: The Optical Resolution of 2:4-dinitro-2′-Methyldiphenyl-6-carboxylic Acid.—Miss D. L. Fox and E. E. Turner: The Scission of Diaryl Ethers and Related Compounds by Means of Piperidine. Part V. The Nitration of Methyl-, Dimethyl-, and Polyhalogeno-derivatives of Diphenyl Ether.—D. L. Hammick, R. G. A. New, N. V. Sidgwick, and L. E. Sutton: Structure of Isonitriles and Compounds of Divalent Carbon.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.1) (Annual General Meeting), at 8.15.—Dr. N. H. Fairley: Sprue: its Applied Pathology, Bio-Chemistry, and Treatment.

FRIDAY, JUNE 20.

ROYAL SOCIETY OF MEDICINE (Laryngology Section) (Summer Meeting), Morning and Afternoon.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—A. J. Wrigley: Puerperal Infection by the Pathogenic Anaerobic Bacteria.

ASSOCIATION OF ECONOMIC BIOLOGISTS.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Midland District Meeting) (at Harpenden).

SATURDAY, JUNE 21.

NORTH OF ENGLAND INSTITUTE OF MINING AND METALLURGY (Newcastle-upon-Tyne), at 2.30.

PHYSIOLOGICAL SOCIETY (at University College).—Prof. L. Lapicque and others: Discussion on The Time Relations of Excitation and their Significance in Central Nervous Phenomena.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (at Norwich).

CONGRESSES.

JUNE 16 TO 25.

WORLD POWER CONFERENCE (at Berlin).

JUNE 21 TO 28.

ROYAL SANITARY INSTITUTE (at Margate).

Monday, June 23, at 3.—Lord Cornwallis: Inaugural Address.

Tuesday, June 24, at 10 A.M.—Meetings of Sections and Conferences.
A.—Preventive Medicine.
I.—Representatives of Sanitary Authorities.
V.—Engineers and Surveyors.
VI.—Sanitary Inspectors.
VII.—Health Visitors (including Personal and Domestic Hygiene).
At 8 P.M.—Dr. O. C. Bradley: Diseases of Domestic Animals from the Human Angle (Lecture).

Wednesday, June 25, at 10 A.M.—Meetings of Sections and Conferences.
A.—Preventive Medicine.
B.—Engineering and Architecture.
D.—Hygiene of Food.
VI.—Sanitary Inspectors.
VII.—Health Visitors (including Personal and Domestic Hygiene).

Thursday, June 26, at 10 A.M.—Meetings of Sections and Conferences.
B.—Engineering and Architecture.
C.—Maternity and Child Welfare (including School Hygiene).
F.—Veterinary Hygiene.
IV.—Medical Officers of Health.

Friday, June 27, at 10 A.M.—Meetings of Sections and Conferences.
C.—Maternity and Child Welfare (including School Hygiene).
E.—Hygiene in Industry.
F.—Veterinary Hygiene.
II.—Representatives of Port Sanitary Authorities.
III.—National Health Insurance Services.

JUNE 22 TO 28.

INTERNATIONAL CONGRESS OF MINING, METALLURGY, AND APPLIED GEOLOGY (at Liège).—In three sections: (*A*) Mining, including Reconnaissance and Preliminary Work, Modern Methods of Working Coal Mines, Metalliferous Deposits and Quarries, Generation and Utilisation of Energy, Extraction, Ventilation (Gas and Dust), and Mechanical Treatment of Ores and Coal; (*B*) Metallurgy, dealing with Blast-furnace Practice, Steel and Ferrous Alloys, Foundry Work, Non-ferrous Alloys and Fuels; (*C*) Applied Geology, covering Metals, Fuels, Hydrology, and Geophysical Prospecting.

SUMMER MEETING.

JUNE 21 TO 28.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in Holland).