NATURE

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National Museums and Galleries.[1]

THE Royal Commission on National Museums and Galleries has completed its labours by the issue of Part 2 of the Final Report. Appointed in July 1927, the Commissioners were given the task of reporting on the administration, buildings, cost, and indeed every phase of the activities of twenty institutions containing national collections situated in London and Edinburgh. An Interim Report was published in September 1928, and the Final Report testifies to the satisfaction which the Commissioners felt in the endorsement of their first recommendations by the Government and by public opinion. The final reports are models of clarity, and bear in mind the national need for economy in the public services, differentiating between what is immediately necessary and what is desirable. Above all, the reports are practical, so far as possible avoiding ideas of change in the governance and methods of the national institutions, provided that they have worked reasonably well in the past. Since many recommendations may be put into effect by the authorities of the institutions concerned, we trust that they will at once receive the closest attention, for there is little doubt that the Commission has accurately expressed leading representative opinion.

In the present report the museums and galleries of Great Britain are considered in turn. Their sixteen governing authorities are not to be altered seriously, this being the natural consequence in the previous report of the recommendation of a Standing Commission charged with the duty of securing co-ordination and reviewing estimates. The governance of the British Museum is a pseudo-hereditary or hierarchic matter, and this is likely to give as high an average of intelligence as could be obtained by any other methods. The power in any event is mainly in the hands of the 'elected trustees', and after all it is difficult to imagine a more impartial electing body than the Archbishop of Canterbury, the Lord Chancellor, and the Speaker of the House of Commons, who themselves are largely selected for their power of judgment of men.

While it may be admitted that practising scientific men are not always the best acquainted with the needs of science, we think that they should not be wholly unrepresented in the 'elected trustees'. These need not be appointed for life, and it is of vital importance in science to have representation

[1] Royal Commission on National Museums and Galleries. Final Report, Part II. Conclusions and Recommendations relating to Individual Institutions. Dated 1st January 1930. (Cmd. 3463.) (London: H.M. Stationery Office, 1930.) 2s. net.

of the younger generations, since each science revolutionises its immediate aims about every twenty years. The Natural History Museum is a vital unit in the science of biology, and its future position and usefulness depend on the due fitting of its wheel with many others, most of which are perhaps represented solely in research institutions and universities. Of such bodies we would not advocate any direct representation; but the payment of due regard to the lines along which biology is advancing, by the selection as trustees of men active and distinguished in research and administration, is a matter which scarcely requires argument.

The Director of the Natural History Museum, as has been proposed by all committees of inquiry, is to be made "wholly responsible for the care and custody of the collections housed therein". The Commission points out that this would require a short Act of Parliament, and, being clearly doubtful of the fate of its recommendation, suggests that the Director at once be given direct access to the Treasury in all matters affecting his museum. We trust, however, that there is no doubt in this matter, and that the requisite steps may be taken to restore the original plan of the legislature, thus rectifying the organisation in accordance with the demand of practically all biologists. As by Darwin and Huxley in the past, so by biologists to-day, the independent responsibility of its Director is deemed to be essential for the development of the Natural History Museum in accordance with modern views.

The Commissioners point out that such development will entail as a consequence that the Museum takes a more active part in expeditions abroad, since the mere collection of animals and plants for the sake of acquisition is of relatively small use compared with definite objectives in respect to particular problems. An increased grant is recommended, and a staff adequate to the duties which it is called upon to perform. Amongst these might be the attempt to increase the educational value of this institution, and a close study of the thoughts of the Commission as to the Science Museum might suggest several lines of evolution of great value.

The need for a lecture theatre for these and other museums on the South Kensington site is endorsed, but it is suggested that, by arrangement, the new theatre of the Royal Geographical Society might satisfy present requirements. This theatre will hold 1000 persons, and this is the maximum size proposed by the Commission. It is not big enough for important meetings of the Society, and we think that, with the development of interest in science, a theatre of at least twice this size is essential, inviting alike the leading men in science and the educated mass in our metropolis. It is essential to the contemplated increase of the Science Museum, so as to give full educational facilities, which is now recommended by the immediate erection of its central block.

The question of the herbaria at the Natural History Museum and at Kew is faced. The Commission has evidently given much time and thought to this question. The members of Sir Michael Foster's committee in 1901, with one exception, were in favour of concentration at Kew. The Commission endorses this as the ideal to be aimed at, but in view of the complications and difficulties to be met, refrains from making any definite recommendation. It is suggested that if the combination could be effected, Great Britain would possess "a centre for botanical study which would be without a rival in the world". This raises a question as to the reasons for exhibiting botanical or indeed any preserved specimens at all in the Natural History Museum. Beautiful and interesting plants and animals, with attractive labels, can teach much; and it might be advisable to retain and develop the exhibited series of plants at South Kensington for the instruction of the public, while relegating research collections to Kew. Again, a possible division of plants (as into water and land forms, *sensu largo*) might perhaps be worth considering, or research on the algæ and fungi might be concentrated in the Museum. Again, Kew is celebrated the world over for acclimatisation and horticulture, and the British Museum for its possession and knowledge of type-specimens; possibly a correlation would be useful which emphasised these characters.

The chief reason against the concentration of the botanical type collections in one place is the capital expense entailed, but this does not apply to the Geological Museum and Survey, the ground for the new building of which is now being cleared close to the Geological and Mineralogical wing of the Natural History Museum. The Geological Museum is 'a research institution', but it is not to be treated as such since one of the best sites in the metropolis is assigned to it and a large part of its building is designed for exhibition. It interdigitates with the biological side of geology, the central institution for which is the Natural History Museum. The latter in its mineralogical division also possesses collections of great beauty and of high importance,

which obviously in their present surroundings can never receive the consideration they demand or attain the popularity they deserve. We are surprised to see in the report no specific reference to them, since their present position is a matter of common discussion, and if they were suitably housed the space they occupy would be immediately utilised for other purposes. As the Natural History Museum must extend its energies into the field, and as its exhibited series depends on research, we dislike the differentiation implied above in the term 'a research institution'. It is not too late for the two authorities concerned to review all the facts between themselves, and it might be economical to relieve the officers of the Geological Survey, who are chosen for research, from all responsibility for exhibition.

The Commission concludes with observations on the adequacy and recruitment of the staffs of the national museums and galleries, but so diverse are the requirements that it can only offer some general considerations. As in most scientific institutions, there is a deficiency in the clerical staff, so that there is a wastage of the energy of the senior officers, who are specialists. The recruitment is under Civil Service rules, which are designed on the idea that a young man of a certain ability can be taught anything to a fair level. This is so, but museums and galleries require certain sections of feeling and learning developed to a supreme degree, if their work is to be properly carried out. Both taste in display and powers of research require characters which are not usually shown until beyond the normal age of recruitment. An investigation of the whole matter is suggested, but we are doubtful whether this is likely to secure results of any importance. Brief courses in universities may lead to a level of mediocrity, which may well be deplorable in its results.

We would be inclined ourselves to suggest the general adoption by the national museums and galleries of the system of pension insurance now in vogue in most of our educational institutions. Thereby the freest interchange would be possible in each section of learning, and inevitably the most suitable curators would gravitate towards the national institutions, upon which the schemes adopted in the provincial museums and galleries depend. It would appear to us a natural step in the unity of learning and research; to promote which unity is the highest function of any university, society, or institution for the furtherance of knowledge. The greatest of these may be the British Museum.

Brighter Chemistry.

At Home among the Atoms: a First Book of Congenial Chemistry. By Prof. James Kendall. Pp. xv + 270 + 16 plates. (London: G. Bell and Sons, Ltd., 1929.) 7*s.* 6*d.* net.

SOMEONE has spoken of chemistry as a science of symbols, and in a sense the allusion is apt, since a skilful system of symbolic representation has lightened the labours of the chemist as much as the wonderful decimal notation has shortened the processes of the mathematician. The peculiar force of a paradox is therefore lent to the reflection that this prime clarifying influence of modern chemistry is a direct outcome of the obscurantism of medieval alchemy. From very early times, indeed, chemistry has been closely bound up with symbolism and mysticism: in ancient Egypt a knowledge of chemical secrets was the jealously guarded prerogative of priests and kings; and at a later day the "sons of Hermes" enmeshed their "precious pearls" of alchemy in a web of enigma, cryptogram, and obscure expression which maintained the high standard of unintelligibility of their patron's famous Smaragdine Table.

Thus, in his "Cours de Chymie", published in 1675, Nicolas Lémery had ample reason to complain that "la plûpart des Auteurs qui ont parlé de la Chymie, en ont écrit avec tant d'obscurité, qu'ils semblent avoir fait leur possible pour n'être pas entendus". Lémery himself was so successful in stripping chemistry of its mysticism that he produced a comprehensive and intelligible text-book which may be read with pleasure even at the present day. So the "Cours de Chymie", which for the first time presented the naissant science to the world in all its native simplicity, became literally a 'best-seller' of the seventeenth and eighteenth centuries; it passed through numerous editions in various languages, and held its place as the authoritative work on chemistry until the time of Lavoisier.

The epoch-making "Traité élémentaire de Chimie", published in 1789, swept away the last remnants of mysticism; while Dalton's "New System of Chemical Philosophy" afforded an indication, some twenty years later, of the coming resurgence of symbolism in the cause of progress. Since the birth of the atomic theory there have been innumerable works dealing with the rapidly expanding science from various points of view, and ranging in size and cost from the lordly and misnamed 'handbooks' of Beilstein and others to plebeian sixpenny primers. Lémery, as we have

seen, presented his information in an attractive form. He had, in the words of Hoefer, "le talent de décrire les choses les plus obscures et les plus arides avec une simplicité et une précision remarquables". Unfortunately, the same cannot be said of some of his successors; for, on the whole, chemical writers have become more formal and arid as knowledge has accumulated.

In the early days of the atomic theory, however, popular expositors of the science were not wanting. Among such writers we may well pause to pay a tribute to Jane Marcet and John Scoffern: for how many contemporary students of chemistry have so much as heard their names! Jane Marcet's "Conversations on Chemistry" first appeared in 1805, and ran through many editions during the succeeding fifty years. The text took the form of a conversation between a certain Mrs. B. and her two pupils, Caroline and Emily.

"To confess the truth, Mrs. B.," says Caroline boldly, at the outset, "I am not disposed to form a very favourable idea of chemistry, nor do I expect to derive much entertainment from it. I prefer the sciences which exhibit nature on a grand scale, to those that are confined to the minutiæ of petty details. . . . I grant, however, there may be entertaining experiments in chemistry, and should not dislike to try some of them: the distilling, for instance, of lavender, or rose water. . . ."

In countering this frank avowal, Mrs. B. points out that Caroline's "want of taste" for chemistry is a consequence of her limited ideas. "You confine the chemist's laboratory to the narrow precincts of the apothecary's and perfumer's shops, whilst it is subservient to an immense variety of other useful purposes. Besides, my dear . . . nature also has her laboratory, and there she is incessantly employed in chemical operations. You are surprised, Caroline; but I assure you that the most wonderful and the most interesting phenomena of nature are almost all of them produced by chemical powers."

If modern ambition should feel disposed to mock such useful pioneering toil, it suffices to quote a passage from one of Faraday's letters:

"Mrs. Marcet was a good friend to me," he wrote to de la Rive, "as she must have been to many of the human race. I entered the shop of a Book-seller and book binder at the age of 13, in the year 1804, remained there eight years, and during the chief part of the time bound books. Now it was in those books, in the hours after work, that I found the beginning of my philosophy. There were two that especially helped me, the *Encyclopaedia Britannica*, from which I gained my first notions of electricity, and Mrs. Marcet's *Conversations on Chemistry*, which gave me my foundation in that science. . . . You may imagine my delight when I came to know Mrs. Marcet personally; how often I cast my thoughts backwards, delighting to connect the past and the present; how often, when sending a paper to her as a thank-offering, I thought of my first instructress, and such like thoughts will remain with me."

Scoffern's "Chemistry No Mystery", published in 1839, is one of the few scientific books containing illustrations by Cruikshank, who made great play in it with the effects of laughing gas and sulphuretted hydrogen. The frontispiece, entitled 'Laughing Gas', has a truly Pickwickian motif: "Some jumped over the tables and chairs; some were bent upon making speeches; some were very much inclined to fight; and one young gentleman persisted in an attempt to kiss the ladies." Moreover, the harrowing story of the lady "made beautifully white" with a preparation of the metal bismuth, who "took a bath in the Harrowgate waters, when her fair skin changed in an instant to the most jetty black", would have made a notable addition to the repertoire of Sam Weller. In this entertaining and informative work, chemistry is ably expounded in a series of twenty-one lectures. The author's point of view is explained in the following remarks addressed to his "dear young friends" in the opening lecture:

"You think", he says, "that young people cannot possibly engage themselves in the study of a science which has been cultivated by such great men as Sir Humphry Davy and Doctor Wollaston—this supposition is wrong. I grant that the very highest order of intellect is often required to make a discovery; but when once made it may perhaps be rendered comprehensible to persons much younger than yourselves; and indeed I cannot think of any necessary portion of chemical science which does not admit of a very easy and agreeable exemplification."

Like his predecessor, Lémery, Scoffern practised what he preached.

These were joyous days for the 'joyous science', for it was in the following year (1840) that Wöhler, writing under the significant name of S. C. H. Windler, published his pseudo-serious contribution to Dumas' ideas on "Substitution and the Theory of Types" in *Liebigs Annalen der Chemie und Pharmacie*. To S. C. H. Windler's statement that "in the decolorising action of chlorine, there is a replacement of hydrogen by chlorine, and that the fabrics which are now bleached in England according to the laws of substitution preserve their

types ", the genial Liebig, entering into the fun, added in an editorial footnote, " I have just learnt that there are already in the London shops fabrics of spun chlorine, much sought after in the hospitals and preferred to all others for night-caps, etc.".

Later in the nineteenth century, chemical literature relapsed into a severe formalism, which has been relieved only during the last few years by the appearance of a number of treatises designed to meet the needs of the growing popular interest in chemistry. The new movement towards a brighter chemistry has been borne along upon the wave of increasing interest in the human side of science, and has found its main expression among the English-speaking communities of the world. Prof. Kendall's book is an excellent example of this new tendency in the exposition of scientific facts and principles. Reducing, as he explains in his preface, the formal side of chemistry to a minimum throughout his treatment, Prof. Kendall develops in a logical and systematic manner the meaning of substances, elements, atoms, and other fundamental chemical conceptions. Having brought us by pleasant ways into the atomic Lilliput, he proceeds to put us " on really intimate terms " with such prominent Lilliputians as oxygen (" the working-girl—Heaven has already protected her "), hydrogen (" nice baby "), and chlorine (" gentlemen prefer blondes "). Later he conducts us around the apartment house of Mendelejeff Court, pausing *en route* to relate to his party the story of young Newlands and " the dear old Tories of the London Chemical Society ".

On the first floor we meet the metals of the alkali family; on the second, we hear of radio-activity, discover that the alchemists were fundamentally right, and rewrite the constitution; on the third, we are told in an impressive stage-whisper that " Al's here ! " ; and eventually we wander out into the country and explore the intriguing mazes of Bohrville. The whole itinerary is enlivened by interesting glimpses of the human and historical side of the subject (including, we are glad to note, a quotation from Mrs. Marcet); while the dark places are unfailingly illuminated by flashes of humour, dashes of picturesque phraseology, and telling illustrations from the things and doings of everyday life; the book also contains numerous explanatory diagrams and plates. " Read Sir John Mandeville's Travels to cure you ", was the advice of Charles Lamb: the convalescent of a later and more scientific age may be recommended to join in Prof. Kendall's personally conducted tour among the genuine marvels of the atomic world.

Up to the present, the revivification of chemical literature has not extended to the periodicals, and if we suggest that the circulation of any one of our standard chemical journals would increase by leaps and bounds if only every hundredth communication were written by a modern S. C. H. Windler, we may perhaps anticipate a reply from " the dear old Tories " in the sense of the concluding words of the excellent Scoffern: " As a young lion torn from the forest is tame and playful, allowing caresses, and joining in every frolic, so we found chemistry; but as it grew up to its full size and strength, it became a thing no longer to be played with; demanding all care, attention, and respect."

JOHN READ.

Prehistoric Art and Symbolism.

Rock Paintings of Southern Andalusia: a Description of a Neolithic and Copper Age Art Group. By the Abbé Henri Breuil and M. C. Burkitt; with the collaboration of Sir Montagu Pollock. Pp. xii + 88 + 34 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1929.) 63*s*. net.

THERE are already several important treatises on the Upper Palæolithic art in the caves of France and northern Spain. There are also several memoirs on the peculiar art, probably of the same age, in the rock shelters of eastern Spain. The subsequent development of this art, however, has not hitherto been exhaustively treated: only a few scattered papers have shown that there is ample material for the purpose in the rock shelters of southern and south-eastern Spain. Since 1913, when the Abbé Breuil and Mr. Miles Burkitt made some preliminary explorations and observations, the Abbé has devoted several seasons to the task of tracing all the more important examples of this later art and making notes in the field. Sir Montagu Pollock has translated and edited the notes for publication, and Mr. Burkitt has added some introductory and concluding general remarks. The result is a handsome volume, illustrated not only by photographs and text-figures, but also by several coloured plates, of which two are due to the generosity of the Marquis of Bute.

The art under consideration is definitely proved to be later than the Palæolithic art of eastern Spain, because it extends into the same area and is sometimes represented in the same rock shelters. When the two sets of paintings are superposed,

those of the Palæolithic phase are underneath. The later art, however, is not characteristically eastern: it has been traced over the greater part of southern Spain, and its centre seems to be Andalusia. It is expressed chiefly in small paintings made by using the oxides and carbonates of iron, probably mixed with fat which has disappeared, and it is preserved only in shelters which are dry. There are very few engravings.

The paintings, which are usually only a few centimetres in diameter, are of particular interest, because they are not naturalistic but reduced to conventional designs, often no more than symbols. The human figure is especially common, and a female is often represented with clothing and head-dress. A form of deer is the only abundant mammal, and the multitude of birds is especially noteworthy. When well preserved, as in the Cueva de las Figuras, in the south-west of the Sierra Momia, the paintings are so numerous and conspicuous that they have long been known to the local people, who regard them as the handiwork of the Moors.

The detailed descriptions and coloured illustrations begin with the shelter or 'cave' of Las Figuras, in which there are more than five hundred separate paintings, not grouped into scenes. Every noteworthy figure is mentioned and explained, and besides several photographs of these figures, there are also many beautiful photographs of the various shelters themselves and the country surrounding them. The whole forms a most valuable work of reference for the student, who may draw his own conclusions, and will be grateful for the guidance afforded by Sir Montagu Pollock's introductory note. In this note, series of conventional paintings of the human figure are collected, to show how the recognisable outline may degenerate into a symbol which would be inexplicable if the successive gradations were not forthcoming. In one series, a man passes into something like a Greek ϕ, in another to a cross, in a third to a star. A multiplication of the arms (as in the case of certain Indian deities) produces a still stranger ultimate figure. A deer, by the multiplication of the legs and the loss of the head and neck, passes into something like a comb. The beginning of symbolism is indeed most evident.

The authors suppose that some of the paintings are considerably older than the others, and suggest the possibility that there is a connexion between the earliest of them and the markings on the well-known Azilian painted pebbles. Mr. Burkitt, however, compares the paintings of the deer and some of the symbols with similar ornament on Spanish pottery which certainly belongs to the Copper Age. If the comparison be justified, most of the art now described is thus either Neolithic or slightly later. This conclusion is so interesting, that archæologists will eagerly await further developments of the research. A. S. W.

Measurement of Animal Environment.

Laboratory and Field Ecology: the Responses of Animals as Indicators of Correct Working Methods. By Prof. Victor E. Shelford. Pp. xii + 608. (London: Baillière, Tindall and Cox, 1929.) 45*s*. net.

PROF. SHELFORD is one of the best-known American students of animal ecology. It will be remembered that, more than twenty years ago, he published a number of studies on the relations between the larvæ of tiger-beetles and the soil and vegetation on the shores of lakes near Chicago, and that more recently he and his associates have been concerned in the study of the relation between the codlin moth and climate. From field work of this type he has progressed in the direction of controlled work in the laboratory. He has not tried to study the animals as a physiologist would, by isolating factors and devising 'good experiments' in which one factor only is allowed to vary. On the contrary, he holds that the ecologist in his laboratory should aim at reproducing the complex, varying, cyclic conditions of Nature. This is a legitimate view, but it is not in accordance with the general scientific maxim that work should proceed from the analysis of simple controlled experiments to the synthesis of more complicated conditions. Parts of Prof. Shelford's book describe the extremely complex and expensive plant, designed to give complete control of temperature, atmospheric humidity, and other factors, and to provide a great variety of combinations of them.

We have found it difficult to know where the line should be drawn between ecology, physiology, and other clearly defined sciences, and some of the contents of the book under notice are unexpected. On the other hand, there are some omissions which we may be permitted to point out. If the index may be trusted, there is no mention of the katathermometer in spite of its recognised value in relating climatic conditions to the life of warm-blooded animals; moreover, the same instrument can be employed to measure currents of air under conditions which prevent the use of most types of anemometer. Prof. A. C. Hardy's plankton recorder

should also find a place in the book. The account of the methods and results of marking migratory birds with metal bands makes no mention of what has been done in Europe: this one regrets, for much work done in Britain, Germany, and other European countries has been very thoroughly carried out and summarised. The list of references at the end of the book will be of great value. As it does not attempt to approach completion, one can scarcely criticise the omissions, but it is noticed that comparatively few references in French or German are included. Surely Mr. Elton's excellent "Animal Ecology" should be among the works to which the student is referred.

Those parts of the book which deal with climate and its effect on animals have interested us particularly, and we find two omissions which appear to be noteworthy. There is a full discussion of the relations between animals and humidity, and on the complication which is introduced by temperature, but there appears to be no allusion to the essential fact that humidity measured as relative humidity has very little biological meaning: yet we know already that it is saturation deficiency which is of importance in the physiology of mammals and of plants. The distinction between saturation deficiency, absolute humidity, and relative humidity is one that is appreciated by very few biologists, and had Prof. Shelford stated it clearly (and possibly represented it graphically) we should have been very much in his debt.

We should also like to see it recognised by ecologists that solar radiation of one type or another is the most important part of climate for plant or animal: it is the least understood and studied, because meteorologists concern themselves so much with barometric pressure and the dynamics of the atmosphere. In reading the section on solar radiation we discovered a curious error repeated several times: it is stated that black-bulbed thermometers are used for recording the intensity of *light*.

The book contains a mass of information on a number of subjects. We know none other which covers the same ground, and it will be continually used for reference, for its particular value lies in the descriptions of methods and apparatus. It gives less attention to field ecology, and does not show the living animal set in a complex environment of climate and soil, living enemy and competitor. When a second edition is called for, we hope the index will be much fuller. The contents of the book are so essentially promiscuous that a full index is more than usually necessary.

P. A. BUXTON.

Fossil Plants from the Coal Measures.

Coal Measure Plants. By Dr. R. Crookall. Pp. 80 + 40 plates. (London: Edward Arnold and Co., 1929.) 12*s*. 6*d*. net.

THE study of British Carboniferous plants will be stimulated and advanced by Dr. R. Crookall's book. Dr. Crookall is palæobotanist to the Geological Survey of Great Britain and is also in charge of the splendid collection of Palæozoic plants made by the late Dr. R. Kidston; he is therefore in a position to speak with authority on Carboniferous plants. The book, however, is not written primarily for the specialist or the botanist, and will recommend itself as an introduction to the subject to geologists who have had no botanical training, to amateurs, and to field naturalists. It will also be of value as a book of reference for university students in connexion with courses on the Pteridophyta and Gymnosperms.

The great advances in palæobotanical research made in the last century in Britain were due very largely to the enterprise of amateurs, among whom may be mentioned that group of Lancastrians, some of whom were working men, whose discoveries of 'petrifactions' of plants in the coal-seams were described by Binney and Williamson. Kidston was responsible for practically all the important work on Carboniferous plant 'impressions' and he received very considerable assistance from other amateur collectors, as well as from the Geological Survey, to which he acted as honorary palæobotanist. But active amateur interest in fossil plants has almost disappeared in the last few decades, probably partly as a result of the complicated terrors of nomenclature and the consequent difficulty of identifying specimens. Dr. Crookall's book, with its clear descriptions and excellent half-tone illustrations, will help to remove this disability.

In many parts of Great Britain the countryside is disfigured with waste tips from collieries, but these afford some compensation by offering a great opportunity to the student of fossil plants. The shales and sandstones brought up from the workings of the mines contain abundant examples of mummified plants, which, with the help of such a book as "Coal Measure Plants", may become intelligible to the non-specialist.

Dr. Crookall in the introductory chapter describes the nature and origin of plant fossils, with a brief account of the stratigraphy of the Coal Measures and a general review of the main divisions

of the plant kingdom encountered in them. Six chapters are devoted to the detailed description of these divisions, with valuable notes on the identification of the important species, and are fully illustrated in the thirty-nine plates. Kidston divided the Coal Measures, on the basis of the plants found in them, into four principal zones, each characterised by certain species and the relative abundance of others, and in the last chapter lists are given of the species characteristic of these zones. In a short appendix some valuable practical advice is given to collectors. A full list of the species described, with the names of their authors and an adequate index, completes the letterpress of the book.

The main object the author has in view is to facilitate the identification of specimens, and he will have achieved this partly by the descriptive chapters, but mainly by the large number of plates containing illustrations of two hundred and forty species. The photographs, which fill twenty-one of the plates, are excellent. The other plates, containing line drawings, which are used by the author to indicate distinctions between species, are on the whole good, but a few of the drawings are unnecessarily crude, and while quite effective for purposes of identification, are somewhat unsightly.

We may congratulate Dr. Crookall on having produced a clear and well-illustrated guide to the study of fossil plants from the Coal Measures.

J. W.

The Design of Scientific Instruments.

The Kinematical Design of Couplings in Instrument Mechanisms. By Prof. A. F. C. Pollard. Pp. 64. (London: Adam Hilger, Ltd., 1929.) 4*s.* 6*d.* net.

PROF. POLLARD'S monograph is a clearly written and well-illustrated little book urging the application of kinematical principles in all instrument design. The basis of his book is the well-known theorem that a rigid body has six degrees of freedom, any number of which can be annulled by an equal number of suitable kinematical constraints, neither more nor less. This singleness of purpose, together with the author's attractive manner of writing, have combined to produce a concise and readable book, which should be closely studied by all instrument designers who are not already acquainted with the principles advocated. Not the least valuable part of the book to the designer are the well-chosen examples of correctly designed instruments, which occupy actually the greater part of the book. The descriptions and illustrations of these leave nothing to be desired.

Prof. Pollard censures the 'machine tool' type of design severely, and with certain reservations we are in full agreement with him. It frequently happens in practical designing that one is reluctantly forced to abandon some kinematically correct feature on account of other considerations, such as wear of the parts or prohibitive contact stresses. An example of this may be taken from the book itself. A knife edge pivot is described, which is quite a beautiful example of kinematic perfection, in which the four necessary constraints are supplied by four steel spheres in contact with the edge. Yet this perfect device is not applied in our balances, presumably because of the excessive elastic deformation which would occur at the four point contacts. Instead of this, the modern balance flagrantly violates kinematical principles, which have to be subservient to other considerations, such as sensitivity and durability. In such cases, as the author clearly explains, only perfection of workmanship can compensate, and the book strongly emphasises the sound procedure of commencing every design on kinematical principles, and only falling back on accurate machining when absolutely necessary.

In the important class of movements having one degree of freedom, such as a sliding or a rotating member, the author strongly advocates the use of commercial steel balls. Where instruments of high precision are concerned, it would seem well to caution designers to employ only balls which will pass a three-point test for sphericity. In most applications the ball is actually in contact with three different surfaces, whereas it is manufactured by a process which ensures uniformity of diameter as measured between two parallel planes, but does not necessarily produce true sphericity.

In one place we should differ completely from the author, where he recommends 'Staybrite' steel as superior to hardened and ground steel, in that it does not require hardening. This special non-rusting steel is in fact incapable of being hardened, except to some extent by cold working, and could not well take the place of hardened steel where hardness is the essential property. The book, however, is not concerned with the materials of instrument design so much as with the principles, and its value to the designer is in no way reduced by the small point on which we have commented.

Our Bookshelf.

Thyroxine. By Dr. Edward C. Kendall. (American Chemical Society Monograph Series, No. 47.) Pp. 265. (New York: The Chemical Catalog Co., Inc., 1929.) 5.50 dollars.

THE researches of Prof. Kendall into the chemistry of the active principle of the thyroid gland are well known: this monograph, however, is much more than an account of his own work, since the study of thyroxine implies the study of the physiology of the thyroid gland. The viewpoint is that of the chemist who is concerned with the relationship of thyroxine to the processes of oxidation in the animal body.

Although Kendall isolated the active principle in crystalline form in 1914, it was not until 1926 that Harington and Barger proved its constitution by synthesis. As a result of his original analyses, Kendall had found that thyroxine contained three atoms of iodine, whereas actually four atoms are present: the explanation of the discrepancy appears to be that volatilisation of traces of organically bound iodine occurred during the alkaline fusion of thyroxine, so that the molecular weight assigned was too low.

Thyroxine is not the only iodine compound present in the thyroid gland: Harington (*Biochem. J.*, vol. 23, p. 373; 1929) has recently isolated diiodo-tyrosine and considers that only these two are present; Kendall, however, inclines to the view that thyroxine may exist in the gland in an 'active' form, since dried thyroid may have quantitatively somewhat greater activity than thyroxine, and also that other compounds are present. He describes also the activities of the various substances which have been isolated from the gland and reviews the evidence on its physiological function: in this connexion he refers to the clinical disorders of this functioning, in so far as they throw light on the influence of the active principle upon the chemical activities of the body. This book should be in the hands of all biochemists, physiologists, and pharmacologists: it will be invaluable as a work of reference, since more than five hundred papers are reviewed in the text.

(1) *Youth: the Psychology of Adolescence and its Bearing on the Reorganisation of Adolescent Education.* By Prof. Olive A. Wheeler. Pp. xv + 202. (London: University of London Press, Ltd., 1929.) 5*s*. net.

(2) *The Child from Five to Ten: Interests and Problems of Early Childhood.* By Evelyn and Miriam Kenwrick. Pp. vii + 299. (London: Kegan Paul and Co., Ltd., 1929.) 7*s*. 6*d*. net.

WE place these two books in juxtaposition because together they constitute a sign of the times. In certain respects they differ markedly. Dr. Olive Wheeler's treatment of her theme is emphatically scientific, whilst the Misses Kenwrick are strong in human sympathy and in practical insight. This is by no means to say, however, that Dr. Wheeler is not human, or that the Misses Kenwrick are not scientific. Each writer gives of her best, and her best is very good.

(1) Dr. Wheeler has chosen the more familiar ground, for the psychology of adolescence has a considerable literature of its own. But besides giving us a more manageable book than Stanley Hall's, and a more adequate one than Dr. Slaughter's, she has brought her account abreast of recent inquiry, including work of her own, and has thought out her subject in connexion with the questions of educational reorganisation that confront England at the present time. "Youth" is both an able and a timely book.

(2) In a sense the Misses Kenwrick break new ground, for the period between infancy and adolescence has not received so much attention from psychologists as these two periods, the one so full of charm, and the other so full of peril. But the child from five to ten, or at any rate from seven to eleven, is destined to become a definite educational problem by himself; so we welcome this book. The writers owe nothing to the method of the questionnaire, or to any studies on the extensive scale. But their keen insight, their experience as teachers, and their adequate psychological equipment, have enabled them to give us valuable intensive studies of individual children.

An Historical Catalogue of Surrey Maps. By Henry A. Sharp. Pp. 56. (Croydon: The Central Library, 1929.) 3*s*. 6*d*. net.

THIS is a handy catalogue of those maps of Surrey which find a place in the Croydon Public Libraries. The list is arranged in chronological order, and the first entry of an original map is Peter Keer's map of Surrey of 1599, published by Speed. We then find entries of maps by Norden; Speed (engraved by Jodocus Hondius), in many forms; Blaeu (1648); Jannson; Blome (engraved by Hollar); Morden (1695); Seller, "Surrey: actually survey'd and delineated" (1733); Rocque, on the large scale of 2 inches to the mile (1762); until we come to John Cary (1754–1835), and the beginning of the more modern type of map. There are altogether 176 different maps or editions tabulated and described, and the work has evidently been a labour of love for the author.

There is an excellent introduction in which the reader will find a great deal of information about the maps of Surrey, and some other matters, such as the story of Mr. Smyth and his Dog. A useful addition in any future issue would be some information as to the amount and value of the original field work which forms the basis of the maps; some account, for example, of Saxton's actual surveys. Saxton was born about 1542, and he has been called the first English cartographer. Keer reduced his maps from Saxton, but it was Saxton who did the field work. Some description of Cary's actual surveys would be of value, and generally, it would be of interest to discriminate between those cartographers who used new material, and those who merely made a re-hash of previously existing maps.

It might be as well, in future editions of this catalogue, to rearrange the entries relating to the Ordnance Survey 1-inch maps. The present arrangement is not perfectly systematic.

Problems of Neurosis: a Book of Case-Histories. By Alfred Adler. With a Prefatory Essay by Dr. F. G. Crookshank. Edited by Philippe Mairet. Pp. xxxvii + 178. (London: Kegan Paul and Co., Ltd., 1929.) 8*s.* 6*d.* net.

THE number of books in English on Alfred Adler's contributions to psychology grows, and the present volume is certainly not the least interesting of them. The principles and practices of 'individual psychology' are exemplified by a number of case histories. The book thus resembles "The Case of Miss R.", which appeared in an English translation some time ago, but it is more comprehensive.

We are strongly inclined to think that anyone desiring a clear introduction to Adler's way of thinking will do better to begin with "Problems of Neurosis" than with the more formal treatment to be found in other books. They will also realise that, like Freud, he gives a doctor's rather than a teacher's psychology, although no hard-and-fast distinction can be drawn between the two. This view is strengthened by the fact that Dr. Crookshank, a medical man, introduces the reader to Adler's text. In doing so he gives a clear and helpful account of the individual psychology.

The convinced Freudian may continue to assume the dominance of the sexual factor in, let us say, the interpretation of dreams. Others, and we believe a majority of students of psycho-analytic literature, will agree with Adler that the sexual factor is determined by the goal of superiority. We think that this book strengthens Adler's position, and at the same time makes a very readable addition to the literature of the subject.

Descriptive Sociology: or, Groups of Sociological Facts, Classified and Arranged by Herbert Spencer. No. 13: *Mesopotamia* (*The Ancient Inhabitants of the Tigris-Euphrates Lands*). Compiled and Abstracted upon the plan organised by Herbert Spencer, by Reuben Levy. Issued by Mr. Spencer's Trustees (T. W. Hill, Editor). Pp. iv + 49 + 4 tables. (London: Williams and Norgate, Ltd., 1929.) 42*s.* net.

THIS wonderful collection of snippets goes on as before. The compiler's industry and the trustees' funds would appear to be practically wasted in the preparation of a commonplace book for the late Mr. Spencer, who is not here to consult it. Under the heading "General Government: Hittites" there is this and nothing more: "*Taxation.* The man who is given absolute possession of landed property must pay a tax on them" (whom ?). If the possession " is only partial, he need pay no tax (*A.O.*, xx. p. 11)". How helpful in dealing 'sociologically' with Income Tax Schedule A: how futile, otherwise ! J. L. M.

Glue and Gelatine. By Paul I. Smith. Pp. x + 162. (London: Sir Isaac Pitman and Sons, Ltd., 1929.) 8*s.* 6*d.* net.

THE author's general survey of the subject, given within a modest compass, should be of interest and use to the technologist and manufacturer. The book includes a consideration of the raw materials used in preparing glue, gelatine, and isinglass; the preservation of stock by the glue manufacturer; the plant used in filtration, evaporation, and other general operations; the analysis and uses of glue and gelatine: together with some historical notes.

The chapter on the chemistry of proteins needs careful revision. In the note on amino-acids (p. 21) the prefixes α and β should be interchanged; the structure attributed to alanine is incorrect; and the representation of the primary amino-group may convey the idea that it is bivalent. Esters are misrepresented in the first two structural formulæ on p. 24; on p. 30 leucine is termed "lencin", and its molecule is credited with a primary amino-group attached directly to a carboxyl group! Another quinquevalent carbon atom is represented on p. 138. Comment is also invited by the use of such expressions as "a strata" (p. 39) and "good-quality glue" (p. 54). The book is well printed, and it contains some interesting illustrations.

Creation by Evolution: a Consensus of Present-day Knowledge as set forth by Leading Authorities in Non-technical Language that all may Understand. Edited by Frances Mason. Pp. xx + 392 + 22 plates. (New York: The Macmillan Co., 1928.) 21*s.* net.

THERE is much to be said for the method adopted by the editor of associating short essays on different aspects of evolution, each written by a specialist, as a body of evidence designed to appeal to the general reader. If there is bound to be a certain amount of repetition, as when the recapitulation theory or the origin of birds from reptilian stock is discussed by different authors, or a certain amount of inconsistency, as, say, in the attitude adopted towards 'species', these weaknesses are more than atoned for by the variety of style and outlook of the individual contributions. The editor has been fortunate in obtaining as witnesses to the reality of evolution some of the best-known biologists in Great Britain and the United States, and the twenty-six essays, which cover an extraordinarily wide and interesting field, are marked by a simplicity of statement (and occasional dogmatism) which will appeal to the plain man.

Lehrbuch der Geophysik. Herausgegeben von Prof. Dr. B. Gutenberg. Lieferung 5 (Schluss). Pp. xx + 797-1017. (Berlin: Gebrüder Borntraeger, 1929.) 18 gold marks.

THE fifth and last part of Gutenberg's "Lehrbuch der Geophysik" has now appeared. Most of it deals with meteorology, and is by Dr. L. Weickmann. The chief instruments are described, and most of the existing theoretical work is outlined. The result is a handy book, with copious references to original papers, which has long been needed. There are some curious omissions; for example, the chapter on atmospheric friction does not contain the name of G. I. Taylor or of L. F. Richardson. The perfect book on dynamical meteorology will not, however, be written for some time, and meanwhile Weickmann's work is a useful approximation. H. J.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Early Rhodesian Gold.

I HAVE not the intention of entering into the correspondence which I hope to see develop further out of Prof. J. W. Gregory's letters in NATURE of Nov. 9 and Jan. 11. If, however, that correspondence is to be profitable to science and clear thinking, may I ask that precise information be given on certain points which have been once more resurrected ? For example :

(a) *Roman Coin from Umtali.*—Who found it ? Who has seen it ? What were its associations when found ? I made inquiries, of course, in Rhodesia, but even the late Mr. R. N. Hall had, it seems, given up faith in it. The history of other coins of antiquity purporting to be South African finds is, when investigated, no more satisfactory. See Prof. Dart's article, NATURE, Mar. 21, 1925, and Mr. Schofield's devastating retort, Mar. 27, 1926.

(b) *Soapstone Birds on Beams.*—What parallels sufficiently close to pass morphological muster are provided by ancient Egypt and Assyria ? Who has published them ? For one would wish, when these birds come to London in the spring for temporary exhibition at the British Museum, to place their counterparts beside them for comparison. This I shall also hope to see done with the ' Rosette ' Cylinder.

(c) *Ptolemaic Beads.*—Who ' referred ' them to this source ? I am, of course, acquainted with Bent's reference. He says ("Ruined Cities of Mashonaland", p. 204), " beads of doubtful provenance, though one of them may be considered as Egyptian of the Ptolemaic period ". They were found " in the vicinity of the Temple " . . . very near the surface. What were their associations ? Celadon, Arab glass, and Persian ware. Deposits, like ladies, have the fortune to be dated by their youngest feature.

(d) *Proto-Arabic Inscription.*—Where was it found and where published ? Bent published ("Ruined Cities of Mashonaland", p. 199) an ' inscription ' on a soapstone bowl, and supposed letters on a rock in Bechuanaland. These were elaborated by Keane, with the result recorded in the *Geographical Journal*, April 1906, p. 346. I have looked at all the bowls in museums but could not identify Bent's inscription. The soapstone bowl fragments we found are a mass of scratches.

Further, why is that nice eighteenth dynasty Ushabti figure from Ndanga always left out of the argument ? Its value as ' evidence ' is not less remarkable than that of the other relics mentioned.

Two more questions. (1) When mining authorities of eminence differ in their estimate of the gold production by £60,000,000 (maximum £75,000,000, minimum £15,000,000), what is the archæologist to do ? I can only suggest that he should read Theal's "Records" carefully, and examine the relics from ' ancient workings ' at Bulawayo and Salisbury. (2) When a coin of Antoninus Pius is found in a mine shaft at Umtali and is considered to date that mine, why should not four Bantu skeletons found in ancient mines be taken equally as evidence ?

So far as space has hitherto allowed, I have put the plain facts of excavation on the table ; these facts are now being dealt with fully in book form, which I hope may be available by the summer. It is fair, therefore, that I, too, should be given facts, so that I may take them into full consideration. Theory I have had offered to me, and generalisations without number. But facts can only be met by facts. Who will supply them ?

GERTRUDE CATON-THOMPSON.

Bedford College,
Regent's Park, N.W.1,
Jan. 15.

Colours of Inorganic Salts.

No satisfactory explanation of the colours of inorganic salts in the vapour state, in solution, or in crystalline form has yet been put forward, excepting certain suggestions by Fajans ("Handbuch der Physik", Bd. 24, p. 564), that the colours are due to the deformation of the cation produced by surrounding anions and molecular complexes. The ideas of Fajans were rather vague, but the time has now come to put forward a more precise hypothesis. It is well known that salts like NaCl, $CaCl_2$, AlC_3, in which the electrons of the cation form closed shells (p^6), are colourless or white. Herzfeld found from a study of dispersion of NaCl that there are three ultra-violet absorption bands, one at $\lambda 340$ which was ascribed to Na^+, another at about $\lambda 1500$, which was ascribed to Cl^--ion. This last one has been experimentally obtained by Pfund (*Phys. Rev.*, vol. 32) by the *Reststrahlen* method. The wave-length $\lambda 340$ ascribed to Na^+ agrees remarkably well with the resonance line of Na^+ identified by K. Majumdar (*Ind. Jour. Phys.*, 1927) and Bowen, though definite assignment of values of the absorption wave-length from dispersion data in this region is subject to certain uncertainties.

Colours are almost entirely shown by the compounds of the transitional group of elements (the first group consisting of elements from scandium to copper). Let us fix our attention on the first group alone, as the same arguments will apply to other groups. The colours are somewhat modified by the anion, or the state of aggregation (solution or crystal), but intrinsically it is due to the cation. Taking a compound like $CrCl_3$, we can say that it consists of a Cr^{+++}-ion, surrounded by three Cl^--ions. The absorption of light in the visible region is due entirely to the outer electrons of the Cr^{+++}-ion. Let us see how this absorption takes place.

The outermost shell of the Cr^{+++}-ion (and generally of all ions of transitional elements) consists of a number of electrons in the *d*-shell. In Cr^{+++}, the number is 3. The multiplicity of the most stable combination state is obtained by adding up the multiplicity vector $r = \frac{1}{2}$ for all the electrons, and the next metastable states are obtained by reversing the vector r for one of the electrons. In d^3, the states are respectively ${}^4X$ and ${}^2Y$, where X and Y are further to be formulated. This is obtained by considering the *l*-coupling according to Pauli's principle, and in the case of Cr^{+++}, $X = F$ and P in ${}^4X$, and $Y = H$, G, D in ${}^2Y$. The average difference in energy between the terms obtained in this way, that is, by having the rotating quantum number all in one direction, and then reversing only one, is about $Ca_v = 20{,}000$, the value increasing with the number of net charges in the nucleus, as shown by the spectroscopic data of Russell, Gibbs and White, Lang, Shenstone, etc. (see various papers in the *Physical Review*).

It is therefore evident that the absorption of light in the visible region is due to some of the α-electrons changing their r-vector from $\frac{1}{2}$ to $-\frac{1}{2}$. This type of transition is possible only in transitional groups, and though usually forbidden they become very prominent in all molecular formations. We cannot, of course, expect that the values of energy difference which we

obtain from spectroscopic studies will continue to hold good in molecules or complex formation, but they will remain of the same order of magnitude. An indefiniteness will be introduced by the modification of the rules of *l*-coupling (*vide* Stoner's suggestive paper in the *Phil. Mag.*, September 1929, which explains D. M. Bose's hypothesis that it is only the rotating vector r which is responsible for the magnetism of the ions of transitional elements in a similar way).

There seems to be no experimental evidence in existence which can be utilised in support of the above hypothesis. The absorption spectra of none of these compounds have been studied in the vapour state (the work of Franck and his school being confined mostly to the study of alkali halogenides). The emission spectra of some of these salts have been studied, but it is difficult to draw any conclusion from them. Other interesting experiments may also be devised to test the above hypothesis. Some of them are in progress.

M. N. SAHA.

Department of Physics,
Allahabad University,
Dec. 27, 1929.

The Heat of Dissociation of the Molecule O_4 and Sutherland's Constant for Oxygen.

THE law of interaction of two colliding molecules follows the curve shown in Fig. 1, where the mutual potential energy U of the molecules is plotted against the distance r between their nuclei. In the case of molecules with saturated bonds, U is determined by the polarisation forces and repulsive forces, the nature of which we do not propose to discuss here. When the chemical bonds are unsaturated, the 'chemical forces' (*Austauscheffekt*) also must be taken into account. In both cases the energy minimum (U_0) corresponds to a definite stationary state of the

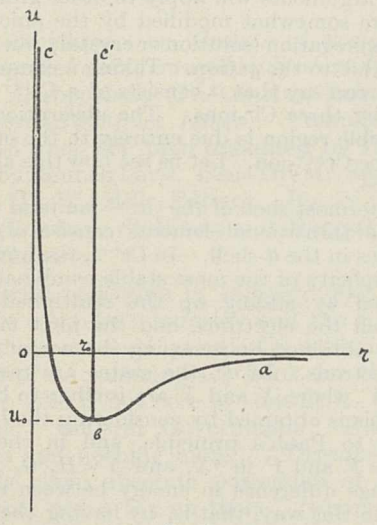

FIG. 1.

associated molecule. Such a twin will appear if the molecules lose during the collision a certain amount of their energy, for example by means of a triple collision, so that the total energy attains a negative value. The dissociation energy W of this twin is equal to $-U_0$ (Fig. 1).

In the kinetic theory of gases, the molecules are regarded as perfectly elastic rigid balls, and the real curve *abc* is replaced accordingly by the curve *abc'*. In this case the mutual energy of two molecules at the moment of collision must be equal to $-U_0$. We propose to show that this energy is nothing else than Sutherland's constant, which determines the dependence of the effective area of the molecule on the temperature.

Owing to the polarisation forces, the effective area for the collision of molecules increases, as may be seen from Fig. 2. The molecule 2, in the absence of

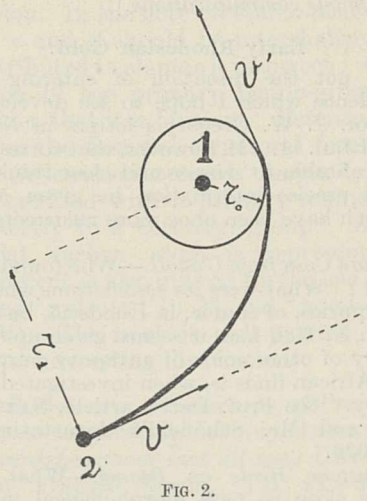

FIG. 2.

the attractive forces, would move in the direction of the dotted line without undergoing a collision with the molecule 1. But the attractive forces will draw the molecule away from the straight line path and a collision may occur. The less the relative velocity of molecules 1 and 2, the greater will be the aim distance r_1, at which a collision still occurs. Let us find now the connexion between r_1 and r_0. From the equations expressing the laws of conservation of energy and moment of momentum, namely,

$$\frac{mv^2}{2} = \frac{mv'^2}{2} - W \quad \text{and} \quad mvr_1 = mv'r_0,$$

where m is the effective mass of the molecules, v and v' are the relative velocities before and at the moment of collision respectively ($v'>v$), we obtain

$$\frac{mv^2}{2} = \frac{mv^2}{2}\left(\frac{r_1}{r_0}\right)^2 - W,$$

or, introducing real and effective target areas of the molecules (σ_0 and σ_1),

$$\sigma_1 = \sigma_0\left(1 + \frac{W}{mv^2/2}\right) \quad . \quad . \quad . \quad (1)$$

This is valid for a single collision. In order to calculate the mean value of σ_1 (for the gas as a whole) we must average the expression (1). We have

$$\frac{1}{mv^2/2} = \frac{2}{kT},$$

and therefore

$$\bar{\sigma}_1 = \sigma_0\left(1 + \frac{2W}{kT}\right) = \sigma_0\left(1 + \frac{2D}{RT}\right),$$

where D is the molar heat of dissociation. Comparing this expression with Sutherland's formula,

$$\bar{\sigma}_1 = \sigma_0\left(1 + \frac{C}{T}\right),$$

we get

$$D = \frac{R}{2}C, \text{ or approximately}$$
$$D \simeq C \text{ cal.} \quad . \quad . \quad . \quad (2)$$

(The calculated ratio $D : C$ depends on the way in which the averaging is done; see, for example, Condon and van Amunge, *Phil. Mag.*, **3**, 604; 1927. However, the order of magnitude of this ratio always remains the same.)

Unfortunately, the failure of the experimental data on the heats of dissociation of twin molecules and Sutherland's constant makes it impossible to prove the correlation (2) in many examples. The values of D and C simultaneously are known only in the case of oxygen. Thus, in order to explain the fact that the oxygen does not obey Curie's law, Lewis (*Jour. Amer. Chem. Soc.*, **46**, 2027; 1924) assumed that in liquid oxygen as well as in oxygen gas, the molecules O_2 are associated to some extent into O_4. Using data of Perrier and Kamerlingh Onnes for the magnetic susceptibility of oxygen at various temperatures, he estimated the molar heat of dissociation of O_4 into $2O_2$ to be about 128 cal. (for liquid oxygen). There are some grounds for regarding this value as approximately correct for the gas. The existence of molecules of O_4 has also been suggested by Wulf (*Jour. Amer. Chem. Soc.*, **50**, 2596; 1928; *Proc. Nat. Acad. Sci.*, **14**, 609; 1928), on the ground of optical data, concerning the absorption spectra of liquid and gaseous oxygen. The identity of absorption spectra due to molecules of O_4 in the liquid and the gaseous states shows that the action of oxygen molecules does not produce any appreciable change in the energy levels of the molecule O_4. On account of this fact, we may suppose that the dissociation energy of O_4 cannot differ considerably in the liquid and gaseous states. For Sutherland's constant for oxygen, different authors give values varying from 127 to 138. These figures are very near to that obtained by Lewis for D. Further experiments will show whether it is a mere coincidence or not.

Experimental work on this problem is in progress in the laboratory of Prof. N. N. Semenoff in this institute. In conclusion, we wish to extend our thanks to Prof. J. Frenkel for his kind advice.

S. BRESSLER.
V. KONDRATJEW.

Physical-Technical Institute,
Leningrad, Nov. 15.

The 'Common Third Level' in the Raman Effect.

IN recent communications to NATURE, Langer and Dieke have pointed out that generally the shifts observed in the Raman spectra correspond not directly to the absorption frequencies of the scattering substance but to *differences between its absorption frequencies*, and that this is in accordance with the dispersion theory of Kramers, Heisenberg and Schrödinger. As a consequence of the quantum dispersion theory, the probability that we should observe a shift of Raman lines corresponding to the transition $E_l \longrightarrow E_k$ is dependent on the probabilities of the transitions from $E_l \longrightarrow E_n$ and from $E_k \longrightarrow E_n$ where E_n is any third common level. The purpose of this note is to point out the significance of the common level from a physical point of view.

In the case of scattering of light by free electrons Pauli (further extended by Einstein and Ehrenfest) (*Zeits. für Phys.*, Band 18 and 19) showed that the probability of scattering of light of frequency ν', when the incident light has the frequency ν, is $a\rho_\nu + \beta\rho_\nu\rho_{\nu'}$. From the classical point of view, scattering is really made up of two processes taking place simultaneously, namely, (1) absorption, (2) re-emission. Hence, even in cases when the frequencies of the incident and scattered light are different—that is, the scattering is not classical—we should expect, from the general ideas of correspondence between classical and quantum concepts, that the mechanism of the process should still be essentially the same as it will be in the limiting classical case. In all cases of scattering, two processes must always take place, (1) absorption and (2) emission. The probability of (1) from the point of view of Einstein is $B_{12}\rho_\nu$, and of (2) $A_{21'} + B_{21'}\rho_{\nu'}$, and hence the probability of scattering of ν' is $= a\rho_\nu + \beta\rho_\nu\rho_{\nu'}$, where $\nu = E_2 - E_1$, $\nu' = E_2 - E_{1'}$.

These considerations can now be applied to the Raman effect.

Let us consider scattering from a molecule possessing only two levels E_l and E_k. When light of frequency ν is incident and is then scattered, the two processes which take place are:

(1) Absorption—the molecule passes from $E_l \longrightarrow E_k$,
(2) Re-emission—the molecule passes from $E_k \longrightarrow E_l$,

and thus, on the whole, the molecule neither takes nor gives anything to the incident quantum, and so the frequency of the scattered light remains ν. If a molecule has only two levels, it cannot give rise to combination (Raman) scattering.

If there be a third common level E_n, the molecule during the processes

(1) may pass from $E_l \longrightarrow E_n$,
(2) may return from $E_n \longrightarrow E_l$ or $E_n \longrightarrow E_k$,

giving rise to the unmodified and the modified lines.

Combination scattering (Raman effect) is, therefore, entirely dependent upon the existence of a third level, and this view also enables us to calculate the intensity of the modified lines.

Kramers and Heisenberg in their original paper discussed the possibility of another allied effect which is theoretically as important as the Raman effect, but has not yet been observed. Generally ν_{lk} is much $<< \nu$, but if $\nu_{lk} > \nu$, as we should expect only in electronic transitions, then when the molecules are illuminated by light of frequency ν, it should excite in the scattered radiation light of frequency ν and $\nu_{lk} - \nu$. A molecule in the excited state k, when subjected to the field of frequency ν, is forced to emit radiation ν. To do this the molecule should revert from the state ν_k to the normal state ν_l, and the balance of energy $\nu_{kl} - \nu$ will appear as another quantum. It can be easily seen that the experimental verification of this prediction will be much more difficult than that of the Raman effect, as we must have a sufficiently large number of molecules in the much largely energy-richer state ν_k.

We may be permitted to mention that the possibility of such an effect was discussed in the local Science Colloquium on Nov. 22, 1929, but we did not publish our views in the hope of gaining some experimental verification. The same view has been expressed by Göppert in a recent note in *Die Naturwissenschaft* (Nov. 29, 1929), but no experimental verification has yet been obtained.

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D. S. KOTHARI.

Department of Physics,
University of Allahabad,
Dec. 17, 1929.

The Fallacious Determination of the Specific Heats of Gases by the Explosion Method.

THE recent gales suggest how fortunate a thing it is that the rate of motion of gas in an equilibration of pressure is not that of sound, which is of the order of 740 miles per hour. The phrase, common among students of gas-explosion phenomena, that 'pressure-equilibrium is attained at the speed of sound' has, indeed, on analysis, no meaning whatever; the rate at which gas moves over a point is a function of the pressure-gradient at that point.

Since the 'eighties, many attempts have been made to determine the specific heats (C_v) of gases by measuring the maximum pressure reached in an explosion of such a mixture that the gas in question is one of the residual gases. Such determinations are fallacious, for when the experimenter has taken the elementary precaution (foreshadowed by Mallard and Le Chatelier) of using a sphere, with central ignition, so that at the moment of maximum pressure all the gas has suffered the passage of flame—a consideration which also dictates the use of a mixture through which flame passes so quickly that buoyancy may be neglected—there is still the difficulty, stated by Sir Dugald Clerk, that the combustion is not then complete.

This incompleteness is not mainly a surface phenomenon, the effect of which would be small and eliminated by the use of different vessels. Ellis and Wheeler have shown that the combustion is most nearly complete in the gas which suffers the passage of flame in the later stages of the inflammation, when the pressure is high, and that the combustion of the gas ignited earlier continues for some time after the moment of maximum pressure—it may be for a period many times as long as that taken by the flame to spread through the vessel.

This result may be shown independently, as follows: Inflammation of the mixture is achieved gradually in successive portions by a continuous ignition, shell by shell, each shell at an initial pressure a little higher than that of its predecessor, and each shell over a greater surface than its predecessor's. As each successive portion of the gas-mixture is thus inflamed, it expands, thus making its own contribution to the increasing pressure, which is entirely derived from this continuous succession of local expansions. On the face of it, one should be very chary of assuming either that the work it lends the system, by its temporary expansion, is necessarily fully repaid again by subsequent compression to initial volume before the moment of maximum pressure, when the last shell of gas is inflamed; or that inflammation when the pressure is low follows the same chemical regime and reaches the same chemical goal as when it is high.

To recognise a continuous succession of local expansions is to recognise in the flame-surface a watershed source of continuous pressure-generation: a pressure-gradient, accompanied by an equilibrating surge, extends inwards towards the centre; and a second pressure-gradient, accompanied by an equilibrating surge, extends outwards to the wall. We are concerned in this letter chiefly with the state of affairs at the moment of maximum pressure, when the last shell of gas becomes flame. It is evident that the inward gradient and the inward equilibrating surge must now extend from the wall to the centre. The speed of this surge, which is the immediate agency by which the inner gases are recompressed toward their initial volume, has, from its inception, been increasingly affected by the chemical action which it has continuously and increasingly induced in the gases suffering this recompression; its speed now begins to be affected also by the contraction of gases in its rear as they lose heat by conduction to the wall of the vessel. This surge must spend itself before the output of energy from the inner gases can be regarded as having ceased.

As corollaries, it may be noted that the inmost portions of the gas are never subjected to a pressure quite so high as that reached by the outermost and registered at the moment of maximum pressure by the manometer at the wall; also that these portions are never recompressed quite to their initial volume: if they finally reach it, it is by cooling.

When the vessel is not spherical, the inward surge may be faster or slower according to the shape of the vessel and the incidence of the cooling-losses. An interesting snapshot photograph of such a surge may be consulted in *Fuel*, 410 (1928).

Summarising, the constitution of the gas in an explosion at the moment of maximum pressure is not known; but it is impossible that it is homogeneous, or that the combustion ceases before sensible cooling has supervened.

OLIVER C. DE C. ELLIS.

Safety in Mines Research Board's Laboratories,
Sheffield, Jan. 11.

Reversibility of Evolution.

I HAVE read with deep interest the report of the lecture by my old friend, Prof. H. Fairfield Osborn, on "Tertiary Man", published in NATURE of Jan. 11. In this lecture Prof. Osborn stresses very strongly Dollo's principle of the irreversibility of evolution; that is, the doctrine that once a structure has been lost by an animal through disuse, even if changed circumstances should again make it useful it cannot be revived.

Whilst accepting this principle as applying to the majority of cases, there are certain exceptions to it which put us on our guard against asserting it unconditionally. One of these—particularly clear—I should like to refer to here. The original dermal armature of the craniate vertebrate appears to have consisted of small teeth embedded in the skin such as are retained to-day in the placoid scales of sharks and rays. As time went on the bases of groups of these teeth became bound together by an ossification of the connective tissue beneath them, and so the bony scale, still found in the archaic 'ganoid' fish, *Polypterus* and *Lepidosteus*, was produced. On the surface of these scales minute microscopic teeth can be detected. Later, as the earlier Mesozoic fish developed into the first true Teleostei of the Cretaceous period, not only these teeth but also the bony layer disappeared, and the scale became a mere horny film as it is in the majority of fish to-day.

Some time in the earlier Eocene these herring-like early Teleostei threw off a fresh-water branch, the Siluroids or catfish. The typical catfish has lost the scales altogether, but some South American forms which inhabit torrential streams, possibly owing to the habit of pressing their bodies closely against the bottom, have redeveloped bony plates in the skin, and, in some genera, on the surface of these plates *small dermal teeth in all respects identical in structure with the placoid scales of sharks*.

I remember well when this extraordinary fact was demonstrated to me by my friend and fellow-student, Pollard, of Christ Church, Oxford, when we sat side-by-side in Naples in 1892. It was fully described by Hertwig and was well known at the time.

I respectfully ask Prof. Osborn to estimate how many million years intervened between the time that the ancestors of Siluroids lost their teeth and the time when their descendants redeveloped them.

We must admit, therefore, that even after an organ has ceased to appear in the normal development of a creature, the power to produce it still remains for an indefinite but varying time embedded in the organisation of the animal and can be revived if the appropriate circumstances recur.

This power may be aptly compared to habitudinal memory, and its calling into action resembles the revival of a half-forgotten habit.

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Tertiary Man.

IN Prof. Fairfield Osborn's address on "The Discovery of Tertiary Man" (NATURE, Jan. 11, p. 55), it is stated, in regard to the discoveries I have made in East Anglia, that Prof. Breuil "shifts the entire pre-Chellean and Chellean flint industries from mid-Quaternary down into the base of Quaternary time, namely, into the first Interglacial or Mindel-Riss stage". The first inter-glacial is, however, that of the *Günz-Mindel*—according to the Penckian scheme—and it is to this phase—represented in East Anglia by the Cromer Forest Bed—that Breuil now relegates the Chellean industry. Prof. Osborn had no doubt in mind Breuil's recently published list of his scientific papers when writing the address referred to, as in this list the impression is given, no doubt unintentionally, that the author was the first to refer the Chellean implements to the first inter-glacial epoch. This impression is, however, incorrect, as no less than ten years ago, in 1920, I published a note in the *Geological Magazine* (vol. 57, No. 671; May 1920, pp. 221-224), in which, with much detail, I set forth my views on the relationship of palæolithic man to the glacial period, and stated (p. 223) that "The Chellean implements may therefore be of *Günz-Mindel* inter-glacial age". When I made this announcement, to which I have adhered with ever-increasing conviction, few, if any, archæologists agreed with my opinion, and it was only after several visits of Prof. Breuil to East Anglia that he was convinced of its truth.

J. REID MOIR.

Entomophagous Parasites and Phagocytes.

IN his interesting letter in NATURE of Jan. 4 on the parasites of the pine shoot moth, *Evetria buoliana* Schiff, Mr. C. C. Brooks gives some figures which seem to indicate a correlation between the percentage of parasitism and the size of the emerging moths, and advances the view that the diminution in size, which he has observed in moths from areas in which the parasitism is high, is due to the fact that some of the parasitised larvæ have recovered from the parasitic attack, so that the adult is able to emerge, although it shows the effect of the feeding of the parasites in its unusually small size.

It is not uncommon to find in caterpillars or pupæ the remains of dead parasites, but so far as I have observed, this is rather rare in cases where the parasitic larvæ have reached a stage so advanced as those mentioned by Mr. Brooks. His suggestion is, therefore, a highly interesting one, and it is to be hoped that he will be able to verify it by dissections.

My object in making these comments is not, however, to discuss the hypothesis put forward by Mr. Brooks; I simply wish to make a few remarks in regard to the view he has expressed concerning the process of recovery from parasitism, and more especially the part played by phagocytes in cases of this kind.

The evidence in favour of the views advanced by Mr. Brooks is, on the whole, very unsatisfactory. What the data actually indicate is that the part played by phagocytes in relation to insect parasites is of very little importance. Metchnikoff, the founder of the phagocytic theory of immunity, long ago pointed out in his "Lectures on the Pathology of Inflammation", that the phagocytic reaction of Arthropods is, in general, very feeble.

In his excellent work on the biology of the parasitic Diptera, J. Pantel (*La Cellule*, **26**, 1er fasc., 1910), whose conclusions were based on the study of a large number of species, states that as a general rule the free and healthy larvæ of entomophagous insects are not attacked by phagocytes.

My own conclusions, based upon the dissection of thousands of individuals of insects belonging to practically all orders, and infested by entomophagous parasites of many groups, agree perfectly with those of Pantel. Healthy parasites, no matter in what stage of the host they are found, are practically never surrounded by phagocytes, provided they lie free within the body cavity of the host. There is no particular reason for believing that the parasite larvæ repel the phagocytes. In sections of parasitised hosts the blood cells seem to be just as numerous in the vicinity of the parasite larvæ as they are in other parts of the body. They are simply indifferent to the parasites, as they are to the organs of the host itself. On the other hand, if a parasite has an anatomical relation with the host, of such nature that destruction of tissue is produced, a considerable accumulation of phagocytes may occur around the point of the lesion. The extent to which phagocytes accumulate is variable and appears to depend in part upon the specific nature of the host, and in part upon its general condition. On the other hand, an accumulation of phagocytes does not appear to exert any effect whatever on the healthy parasites.

A brief summary of the results obtained by me up to that time was published in 1915 (*Bull. Soc. Zoologique de France*, **40**, pp. 63-68). A detailed account is now in course of preparation.

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Scattering of α-Particles by Light Atoms.

IN a recent discussion at the Royal Society (NATURE, vol. 123, p. 246), Sir Ernest Rutherford pointed out the great importance of the experiments on the scattering of α-particles by light atoms like those of magnesium, aluminium, helium, and hydrogen which are being carried out at the Cavendish Laboratory by himself and his co-workers Bieler, Chadwick, and others. The results of these experiments show very wide variation from the classical expression obtained on the assumption of an inverse square law, and led Rutherford and Bieler to the view that the repulsive force between positively charged particles changes into an attractive one when the distance of approach is less than 3×10^{-13} cm. Many attempts have been made to get an exact expression for this force. Bieler thought the force to be given by the law $F = \frac{Ze^2}{r} - \frac{\mu}{r^4}$, while Debye and Hardemeier took the additive term to be inversely proportional to the fifth power of the distance.

While the exact form of the law will probably take some time to discover and will probably be given by some developments in the generalised theory of relativity, it is profitable to see how far the assumptions of these additional forces can be justified from the point of view of wave mechanics. Born has given a general way of treating collision problems on wave mechanics, and Wentzel, Sommerfeld, and Mitchell have deduced, by the use of Born's method, Rutherford's classical expression for the scattering of α-particles. I have tried to explain abnormal scattering of α-particles by light atoms from wave mechanics by using the law $F = \frac{Ze^2}{r^2} - \frac{\mu}{r^n}$. It appears that the equations can be solved by the polynomial method only when $n = 3$. Using this value of n, I have deduced an expression for scattering which is in very good agreement with the results obtained in the Cavendish laboratory.

The assumption of the same law in Schrödinger's

equation enables us to calculate the 'Eigenwerte' of α-particles in the nucleus. Discrete positive as well as negative 'Eigenwerte' are obtained, according to initial conditions assumed. The positive 'Eigenwerte' are very interesting, because with certain further assumption they are capable of explaining the γ-rays of the six radioactive elements which have been so far accurately measured. The numerical agreement is very remarkable.

The complete papers will be published in the *Philosophical Magazine*.

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Dec. 11, 1929.

Nitrifying Bacteria.

DURING the course of investigations on nitrification in soil and in a sugar beet effluent filter bed, several different bacterial strains have been isolated capable of oxidising various ammonium salts to nitrite, as shown by the Griess-Ilosva method. This is interesting because it has usually been assumed that nitrite formation was brought about by the varieties of bacteria known as *Nitrosomonas* and *Nitrosococcus* first isolated by Winogradsky in 1891. There are, however, scattered references in the literature to other organisms capable of producing nitrite from ammonia, but unfortunately the diagnostic characters given are insufficient for sure identification. Among the well-known characteristics of Winogradsky's organisms are the following: inability to grow on nutrient agar or gelatine, inhibiting effect of organic compounds such as sugar, optimum growth at *p*H of 7·7 – 7·9. In contrast to these the organisms isolated in this laboratory grow well and rapidly on both nutrient agar and gelatine (in the case of the soil forms Winogradsky's medium is unsuitable); the presence of 0·1 per cent sucrose in no way inhibits growth, and in the soil forms definitely stimulates nitrite production. Nitrite formation takes place at a wide range of *p*H values varying from 4·5 to 7·9.

Further, morphologically, the varieties of *Nitrosomonas* and *Nitrosococcus* on the whole do not resemble the soil and effluent forms isolated here.

This new group of organisms has up to the present been shown to produce nitrite when grown in a culture solution of the following percentage composition: 0·06 sodium chloride; 0·002 calcium chloride; 0·0005 magnesium sulphate; 0·03 potassium acid phosphate; 0·1 sucrose; the only sources of nitrogen being one of the following ammonium salts, sulphate, phosphate, carbonate, chloride, lactate, or acetate. Some of the strains produce nitrite from all the ammonium salts tested, while others will only produce it from certain of them. On the whole, the organisms isolated from the effluent produce nitrite more freely from ammonium lactate and the soil forms from ammonium phosphate.

A full description of these bacteria, together with their physiological reactions, is in the course of preparation.

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The Life-Cycle of *Bac. saccharobutyricus* v. Klecki.

IN 1927, Cunningham and Jenkins (*Jour. Agric. Sci.*, Vol. 17, pp. 109-117) showed that under certain conditions the motile butyric acid bacillus is capable of producing ærobic micrococci. Studies of this organism continued during the intervening period of three years have demonstrated that it passes through a life-cycle in which at least seven distinct cell types can be distinguished—forms similar to the (1) coccoid, (2) short rod, (3) slender rod, (4) large rod, (5) dwarfed growth, (6) fungoid, and (7) large cell types of Löhnis and Smith. Of these, representatives of types 1 to 4 have been stabilised and the majority have been identified with previously described 'species'.

The cocci consist of white, orange, and red forms corresponding to *M. candicans* Flügge, *M. aurantiacus* Cohn, and *M. roseus* (Bumm) L. et N. The short rods are represented by unidentified white and red types. The more important of the slender rods are *B. putrificus* Bienstock, *B. sporogenes*, Metchnikoff, *B. putrificus* Reddish and Rettger, *B. circulans* Jordan, *Pectinobacter amylophilum* Makrinov, and *B. Globigii* Migula, while the large rods are represented by *B. Ellenbachensis* Stutzer and *B. sphæricus* A.M. et Neide.

Formation and germination of endospores, exospores and microcysts have been observed as well as formation of gonidangia, gonidia, and regenerative bodies. Observations have also been made on the formation of, and regeneration from, the symplasm, and on conjunction with formation of regenerative bodies at the points of contact of the cells. When cultures of the slender rod type produce terminal regenerative bodies they have been found to be capable of decomposing cellulose under anærobic conditions. A detailed account of the results of the investigation will be published elsewhere.

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Regeneration of the Spines in Sea-Urchins.

IN NATURE of Nov. 16, p. 760, Mr. H. C. Chadwick records a case of regeneration of the spines in *Echinus esculentus*. While working at the Marine Laboratory, Plymouth, last summer, I noticed a number of specimens of *Psammechinus miliaris* behaving in a similar way. The individuals belonged to a small, deep water race obtained from about 15 fathoms near the Eddystone. On July 25 about thirty specimens were placed in a bowl under circulation and kept in darkness. A similar number were exposed to direct sunlight. The former lot remained healthy and underwent no change. About half of the lot kept in the light threw off all their spines except those on the oral surface, which were unaffected. A week afterwards a fresh crop of minute spines began to appear. These grew so rapidly that in two months the majority of these individuals could scarcely be distinguished from those which had not thrown off their spines.

It may be noted that Dr. Mortensen states in his "Handbook of the Echinoderms of the British Isles" (1927, pp. 262-263) that in sea-urchins "The power of regeneration is great, . . . spines and the other external organs are easily regenerated. . . . Autotomy is not known to occur in the Echinoids."

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Ruthenium a Superconductor.

IN some experiments recently made in collaboration with J. F. Allen and J. O. Wilhelm, we found ruthenium became superconducting at 2·04° K. The metal was supposedly of high purity, but retained its high resistance down to nearly 4° K.

J. C. MCLENNAN.

The Great Telescopes of the Future.[1]

FOR some ten years past visitors to the Observatory of Paris have found Dr. Ritchey installed on the top floor, working out his optical ideas. These ideas are the fruit of his long experience in the use and construction of telescopes, first at Yerkes and later at Mount Wilson. They are thus very mature, and unless we are to discard experience altogether, they deserve the most careful consideration.

The publication before us has been distributed by the great glass-making firm of St. Gobain. M. Delloye, the manager, to whom Dr. Ritchey pays many grateful acknowledgments, states that it arose from the wide interest excited by a presentation in Paris, by the Company, of Dr. Ritchey's celestial photographs. Accordingly, to make the presentation permanent, the company has issued half-tone reproductions of nineteen of the finest photographs, together with several others illustrating Dr. Ritchey's experience and projects. Most of the pictures are included in the excellent series of astronomical photographs which are available through the Royal Astronomical Society, and one gets the impression that they are familiar by their incorporation in various popular books. A careful scrutiny, however, shows that the present publication leaves far behind the best that has been produced before; and in that connexion it is germane to recall that *all* the best photographs of stellar and nebular fields were made by Ritchey, and the most sensational of them were made by telescopes the chief parts of which, both optical and mechanical, he had made, and in many cases had devised also. On revision of that sentence one may add Barnard's name, but no other. This should not be forgotten in considering the outlook for the future.

The text of this brochure has been written in English, and translated into French, somewhat carelessly. Both versions appear side by side. In no case is the French an improvement upon the author's careful wording. In one case the French text achieves the exact opposite of the English, as when "Nous avancerous ainsi lentement, mais sûrement" does duty for "We shall thus advance by *long, sure* steps". What is of interest, in addition to these epoch-making photographs, is an outline of Ritchey's view of the right construction for the great telescopes of the future. Those who wish for a fuller account of the same will find it in the *Transactions of the Optical Society*, **29**, p. 197 (1928)—the Thomas Young Oration—where details, numbers, and references, here lacking, are given.

It is evident from this publication that Ritchey is still ardent and unwearied in the pursuit of more, and still more, perfect and powerful optical means. That may seem an obvious thing to say. But improvements of means demand an ever stricter discipline in their use, and there is a good deal to be advanced for getting full service out of the instruments we possess. It is possible to spend so much time in preparation that nothing is left for achievement. But let that be the consolation of those who must be content with something less than the best. It is evident that if we are to penetrate further into space—and the remote, small objects are at least as significant as those we happen to be near—we must have greater power. Now few look for a greater refractor than about 40 inches. Even the 100-inch reflector is not likely to be surpassed without change of plan. But as readers of NATURE know from an article in the issue of Dec. 21, 1929, the California Institute of Technology has been furnished with the funds for a reflector of 200 inches, and the plans are already energetically advanced, by Dr. G. E. Hale, assisted by investigators of every type. In the conduct of these investigations no door has been closed in advance, and any location and any type of telescope may be adopted. But so far as they go, they seem to point to a repetition of the 100-inch as to mounting, and as to the mirror, a solid disc of fused silica, faced with fused quartz. The total weight of the moving parts is estimated at 500 tons. To intensify the light-gathering the focal ratio is to be unusually short, 3·3, and is to be shortened still further by an interposed lens which is also to correct the field for coma.

Everything depends upon a right choice, but it is scarcely the place of those outside the scheme to follow the decisions that must be made with anything except hearty good wishes for their success.

The design of a super-telescope to which Dr. Ritchey has been led, and which he has gradually developed, but varied very little, in a lifetime of study, is quite different, and in many ways it is bolder in its novelties. First of all he would not have a solid mirror, which for the 200-inch size must weigh 30 tons. He could build it up of a back- and a face-plate, separated by a honeycomb structure, also built of thin plates of the same composition. Weight could be reduced to one quarter, support could be made by flotation, or at the centre of gravity; air could be circulated throughout. A reduction in the weight of the mirror permits a proportionate reduction elsewhere. Intensification of light-gathering and correction for coma would be produced by 'figuring' from a Cassegrain model, on a plan devised by Prof. Chrétién and himself. The telescope building would be in the form of a tower, at the top of which would be a dome containing two flat mirrors of which one only rotated in the ideally simple cœlostat manner, and sent a vertical beam through the centre of the tower to the great mirror which lay fixed in a horizontal position. This construction permits immediate change of the secondary mirrors, thus multiplying the uses of the telescope. Not unimportant, the observer would also be in an easy position. There are many other details of technical interest, but they must be passed over here.

It is again scarcely useful to express or to form an opinion upon these proposals. What is impracticable to one pair of hands, may be perfectly successful in another. Most seems to depend upon the

[1] L'Évolution de l'astrophotographie et les grands télescopes de l'avenir (The Development of Astro-photography and the Great Telescopes of the Future). Par G. W. Ritchey. Publié sous les auspices de la Société Astronomique de France. Pp. 36+34 planches. (Paris.)

success of the built-up mirror. Cemented glass is usually reckoned a tricky construction, with a horrible aptitude for flying and tearing flakes off the face it is cemented to. As against this, Dr. Ritchey in 1911 and 1912 made two flats in this way, 20 inches in diameter, and they have since behaved beyond reproach. He figures in these publications the honeycomb part of a 60-inch mirror, and also a more advanced stage, but it does not appear to have ever been completed. If it is a question of funds, I submit that it would be well worth the while of those interested in the major problem, to see that that experiment, which has been carried so far, is tried out and not left inconclusive. R. A. S.

Denudation in the Punjab Hills.

THE denudation of mountain slopes, as a result of the ignorant clearance of forest under the combined activities of the lumberman, fire, and excessive grazing, and the resultant damage is not a new problem and has been previously referred to in NATURE. For centuries the Alps have furnished examples of the difficulties which governments have to contend with in combating the ignorance of the local population on the subject of the actual causes from which the trouble arises. Throughout the Mediterranean, large areas of bare hills form an object lesson of the same kind, whilst America provides the most recent examples of the inevitable results following wholesale destruction of the vegetation in hill and mountain areas through excessive logging, often followed by extensive fires, and over-grazing. A recent paper on "Denudation of the Punjab Hills" (*Ind. For. Records, Sylv. Series*, vol. 14, pt. 2; 1929), by Mr. B. O. Coventry, traces the history of denudation and its results in the province. Mr. Coventry is a conservator of forests and has been in the province since 1895. His treatment of this important matter and the conclusions he has arrived at merit careful attention.

The monograph commences with a consideration of the forest vegetation and evidence of denudation. The main topographical tracts are distinguished as (1) The Himalayan tract; (2) The Sub-Himalayan tract, comprising the lower hills up to about 3000 ft. and including the Salt Range on the west and the Siwaliks on the east, two outlying ranges of hills rising from the plains to about 3000 ft.; (3) The Plains.

The climate in these regions varies considerably, the rainfall being about 30 in. per annum near the foot of the hills to 5 in. or less in the south of the Plains. Mr. Coventry, in considering the denudation problem, divides the climatic or forest zones as follows: (1) *Plains*—Tropical zone (below 1000 ft.), zone of *Prosopis spicigera*. (2) *Sub-Himalaya*—Sub-Tropical Zone (1000 ft. to 3500 ft.), zone of *Acacia modesta* (forests in east differ from those in west). (3) *Himalaya*—(a) Sub-Temperate Zone (3500 ft. to 5500 ft.), zone of *Pinus longifolia*; (b) Lower Temperate Zone (5500 ft. to 7500 ft.), zone of *Pinus excelsa*; Upper Temperate Zone (7500 ft. to 9500 ft.), zone of *Abies Pindrow*; Sub-Alpine Zone (9500 ft. to 12,000 ft.), zone of *Betula utilis*; Alpine Zone (above 12,000 ft.), no tree growth.

It will be understood, as is invariably the case in mountainous regions, that aspect, exposure, and latitude modify the appearance of a species in a locality; and there is no clearly marked line of demarcation between two adjacent climatic zones though these are separated by what may be regarded as a 'neutral zone' where species of the two zones flourish equally well. Moreover, each of the above forest zones is not occupied by one type of forest alone, but different kinds of forest occur in the same zone, and the factors determining the distribution of the types are edaphic or soil factors. The species which will regenerate on dry soils are termed 'xerophytes', and those which require moist soils 'mesophytes'. These terms become important when it is considered that whereas a seedling may find the requisite soil conditions to enable it to become a well-established tree, its root system then going deep down in the soil, subsequent denudation may remove all the surface soil, thus preventing further seedlings developing on the area. Owing to this fact, as the author points out, and to the great age to which some species live, "it is not uncommon to find a forest of a particular species growing on a soil" or even on bare rock "which is quite different from the kind of soil it requires for its natural regeneration or upon which its distribution is dependent". A change from a xerophytes type of vegetation to a mesophytes type in the series is regarded as a case of 'progression', whilst the contrary is looked upon as a case of 'retrogression'. One part of Mr. Coventry's observations has been devoted to a study of the 'retrogressive' changes in the vegetation of the Punjab Hills. After discussing the forest vegetation in the different forest zones (for which the reader is referred to the monograph) the retrogressive changes in the different zones are summarised as follows:

The forests in each zone are generally undergoing retrogression. In the Sub-Tropical zone the climax formations of olive (*Olea cuspidata*) forests and other mesophytic types are changing to brushwood forests of *sanatha* (*Dodonaea viscosa*). In the Sub-Temperate zone the mesophytic and climax formations of oak are changing to *chir* pine (*P. longifolia*), and the *chir* pine forests are generally deteriorating in quality. In the Temperate zone climax formations of oak or other broad-leaved species are changing to blue pine (*P. excelsa*). In other words there is a general tendency for the climax and mesophytic types to change to more xerophytic types indicating a general change from moist to drier soil conditions. Although these conclusions have been arrived at from observations with regard to the vegetation chiefly on the Murree and Kahuta hills, they apply

more or less equally to the vegetation on the hills throughout the Punjab, including the Indian States of Kashmir, Chamba, Poonch, etc.

Evidence of denudation is then considered; and everyone having acquaintance with the Province will appreciate the truth of the following description:

A considerable proportion of the hills of the Punjab, exclusive of areas under cultivation, are bare of forest vegetation, especially in the lower zones, but it is evident from a study of the forest vegetation of the neighbouring wooded hills, and even to the most casual observer, that these bare hills were previously densely wooded everywhere within the limits of tree growth and at no very remote date. There is evidence in some localities of hills having become denuded of their forest vegetation within comparatively recent years, and the older inhabitants of many of the villages can give instances where hills have become more or less denuded within their lifetimes. Considerable areas of village forest lands which were known to be well wooded at the time when the Forest Settlements were drawn up about forty to fifty years ago, have since been more or less completely denuded of their vegetation, especially in the lower hills. Some of the villages now experience considerable difficulty in obtaining sufficient timber and firewood or fodder, whereas formerly they had ample supplies available. There is evidence in old historical records of hills which are now in a denuded condition being previously densely wooded. For instance, in the Gazetteer of the Kangra District there is an interesting account taken from old records of the conquest of Mau and Nurpur under Shah Jehan about 300 years ago, in which reference is made to the 'impenetrability of the jungles' at that time, but these jungles are no longer existent. Again some of the old Atlas sheets prepared from surveys made 60-70 years ago show tracts of low hills as densely wooded, which are now in a denuded condition.

Although there is ample evidence of great denudation having taken place in the past, the retrogressive changes accompanied by erosion of the surface soil which have been shown above to be taking place in the existing forests is evidence that denudation is still actively in progress at the present day, and it requires little imagination to foresee that if this steady process of denudation continues unchecked the hills of the Punjab must sooner or later become more or less completely denuded of soil and vegetation and reduced to a desiccated condition.

As to the causes, Mr. Coventry dismisses the theory that there has been any change of climate responsible for the desiccation, remarking that there are living trees in existence of olive, oak, and deodar which cannot be less than a thousand years in age, and these species still regenerate and grow vigorously in the same localities provided the conditions of soil are suitable. In common with a number of other authorities, he allocates the blame for the present state of the hills upon man, (and not climate), to whom the retrogressive changes in the vegetation are due, the changes being traceable to changes in the soil following erosion.

If, however, the erosion of the surface soil is simply to be regarded as the normal result of disintegration and gravity and has always been in progress to the extent to which it is taking place at the present day, it becomes impossible to explain how the hills ever became clothed with forest vegetation, and especially with the climax formations on deep deposits of humus soil. This can only have taken place when there was a condition of more or less equilibrium, that is to say when soil was accumulating as rapidly as, or more rapidly than, it was being eroded away, and it seems evident, therefore, that some factor has come into play which has upset this previous condition of equilibrium, resulting in erosion of the surface soil, which is gradually denuding the hills of soil and vegetation. All the evidence which is forthcoming shows very conclusively that this factor is man, by means of fires and grazing of his cattle.

Outside the broad-leaved type, when not opened out, the only type of forests which are resistant to fire are the Chir pine forests. These have been burnt periodically from remote times. The persistence of the tree is due to its thick bark. But each time the forests are fired a certain amount of soil erosion follows, and eventually the forest degenerates into scattered stunted trees standing on more or less bare rock, of which there is an excellent illustration in the monograph. Next to fire comes grazing of the large flocks which the hill people keep, exceedingly poorly bred and of little value. The trouble during the past fifty years has been due to the almost unlimited recognition by the old Settlement officers of the peoples' rights to graze the flocks over large areas of the hills. With the impoverishment of the forests and increasing denudation, grass and browsing materials greatly decreased and the people took to lopping the trees. In the Report of the recent Royal Commission on Agriculture in India (1928) it was remarked that no complaints as to serious damage being done by lopping of trees were received. There are, however, plenty of instances in the North-West Himalaya; the practice is a most serious factor in the work of denudation.

It is unnecessary to follow the author into his treatment of the effects of denudation—floods, water supplies, and irrigation, and so forth. As regards remedial measures he prescribes the introduction of an organised pasture management. He does not appear to be acquainted with the methods found in France, where areas of pasture are managed in conjunction with rougher grazing and timber forest (from which animals are excluded). The whole area may be communal or village-owned—but is managed under the supervision of the Forest Department. This system of management is on the lines Mr. Coventry advocates, but in France it is established.

In the Punjab the Government is faced with the difficult work of afforesting the denuded areas. This will demand high skill and sufficient funds. But that the matter is urgent Mr. Coventry's monograph well displays. Others have stressed the same warning. The fate and future of the great irrigation schemes in the Punjab plains are directly dependent upon the preservation of the water supplies in the hills and the prevention of further denudation and the arrest of what is taking place. Government has already had warnings by means of bad floods in the past.

Last year flooding and wholesale damage were on a terrible scale, and it may be hoped that the appearance of Mr. Coventry's brochure may pave the way to a better understanding of this serious problem.

The monograph may also be commended to the Colonial Office and its officials. For there are many other parts of the British Empire where the same conditions as Mr. Coventry describes in the Punjab Hills are being produced and by the same agencies. It forms one of the large and pressing problems of the day in such regions.

Obituary.

Dr. Sebastian Z. de Ferranti, F.R.S.

SEBASTIAN ZIANI DE FERRANTI was born in Liverpool on April 9, 1864, and was educated at Hampstead School, St. Augustine's College, Ramsgate, and at University College, London. Even from his earliest days he showed a great bent towards engineering invention, and before he left school he began to build a dynamo. When he was only seventeen years of age the first Ferranti machine with its coreless disc armature was installed in the arches under Cannon Street Station. In the year 1882 he and Mr. Francis Ince went to Glasgow to interview Sir William Thomson (Lord Kelvin) to try to arrange a working agreement with him, as it was found that one of Thomson's patents partly anticipated Ferranti's invention. An agreement was arrived at, but it placed rather too heavy a burden on their manufacture. In 1883 the firm of S. Z. de Ferranti and Co., the forerunner of the large works at Hollinwood, Manchester, was established at Charterhouse Square. I remember going over this factory so long ago as 1890 and being greatly impressed by seeing hundreds of Ferranti meters all connected in series being tested.

In 1883 the late Lord Crawford and Sir Coutts Lindsay decided to adopt electric lighting at the Grosvenor Gallery in Bond Street. They installed a small plant, but the urgent requests of neighbours led them to enlarge it, and Ferranti was put in charge. He planned 2500 volt overhead conductors and underground mains, and supplied an area extending from Regent's Park to Charing Cross and from Lincoln's Inn Fields to Albert Gate. This was a marvellous feat for that period, but Ferranti's magnetic personality attracted an enthusiastic band of assistants, to whom he used to attribute much of his success. He was soon convinced, however, that Bond Street was not a suitable site for a power station. He saw that in order to supply electricity economically it was necessary to build a large generating station in a place to which coal could be conveyed cheaply, where rents were low, and where abundant water could be had for the boilers and condensers. He visualised that to light London it would be necessary to obtain a site in the suburbs near the river and to transmit electricity to substations at the high pressure of 10,000 volts. The site he selected was at Deptford, some eight miles from the centre of the load, and there he built a great power station, having machinery of more than 40,000 horse-power and generating at 2300 volts. The pressure was then raised to 10,000 volts and transmitted to the substations. The scheme was taken up enthusiastically by Francis Ince, Lord Crawford, Lord Wantage, and others, and the London Electric Supply Corporation, Ltd., was founded.

With practically no previous experience to guide him, as this was the first high-tension station in the world, Ferranti designed by himself generators, transformers, mains, and all the necessary complicated switchgear. Serious difficulties were soon encountered; amongst others the resonance phenomenon called the Ferranti effect. At this period, when even his strongest supporters began to waver, Ferranti pushed resolutely forward, overcoming difficulty after difficulty, and undeterred by breakdowns until success crowned his efforts. He frequently consulted Sir William Thomson professionally, and the latter found some of his problems of absorbing interest. In particular he computed the effect produced by the rapidly alternating current in increasing the resistance of the Deptford-Trafalgar Square mains.

In 1892, Ferranti resigned his post of engineer to the London Electric Supply Corporation, and devoted himself exclusively to the manufacture of electrical apparatus. His works were finally established at Hollinwood, near Manchester. They supply every kind of apparatus for electric lighting, and their transformers, meters, and radio apparatus are very widely used. In particular Ferranti designed and installed the million-volt transformer which is now in use at the National Physical Laboratory, Teddington.

In 1910, Ferranti gave a remarkable presidential address to the Institution of Electrical Engineers, in which he prophesied the trend of future electrical development. In the electrical age to which he looked forward all the world's drudgery would be done by automatic machines—'robots' driven electrically and controlled by human minds. The enormous saving in labour and waste would be a priceless boon to humanity. Assuming that everything were done as he suggested, he calculated that the average cost of an electric unit would be reduced to $\frac{1}{8}$th of a penny. He assumed that the nitrogen in the fuel would be recovered in the form of ammonium sulphate, which could be used for the intensive cultivation of home-grown food. Coal could be conserved, and as there would be less smoke there would be more sunshine. It was a remarkable address delivered in a most pleasing and attractive way, as if it had been composed with little or no labour. He told me, however, that he had spent laborious months composing it and checking the necessary calculations.

Ferranti married the second daughter of Mr. Francis Ince, a solicitor who gave a great impetus to the electrical industry in its early days. One of Ferranti's sons, Basil, was killed in the War, after distinguishing himself as a major and gaining the military cross; another son, Vincent, is a director of Ferranti's. Ferranti's home at The Hall, Baslow, Derbyshire, was fitted up with every electrical convenience, including even artificial sunshine. His seaside house in Wales was also 'all-electric'.

He was a great motorist, and for his summer holiday he often went for a motoring tour abroad. In the winter he and some of his family went to Switzerland for the winter sports. On Dec. 19 last he attended the meeting of the Institution of Electrical Engineers, at which Mr. Haldane read a paper on a heat pump which reversed the Carnot cycle of operations. Ferranti was enthusiastic over it, and reminded me that Prof. Perry as well as Kelvin had advocated reversing the Carnot cycle. He was just starting for his winter holiday, and was looking forward to skating and to seeing his children and grandchildren taking part in more active sports. His death at Zurich on Jan. 13, following an operation, came as a great shock to his many friends all over the world.

Ferranti, through his father-in-law Mr. Ince, was closely connected with Faraday House Electrical Engineering College. At the old students' dinner on Oct. 25, in proposing the toast of the College, he encouraged the students by reminding them of his own strenuous struggle during the days of his youth. He missed in his student days, by a hairbreadth, the invention of the tungsten filament lamp and the induction motor. He attributed these failures to lack of technical knowledge, and urged the students to use every endeavour to widen their knowledge. One could never tell what scientific fact would give the key to an invention.

Ferranti was a great inventor and engineer, one of the greatest the world has ever seen. We need merely mention the mercury meter, the Ferranti alternator, the Ferranti rectifier, the Ferranti concentric cable, Ferranti switchgear, the Ferranti steam engine, the Ferranti steam valve, his system of earthing, his induction furnace, his high temperature improvements of the steam turbine, his systems of electric welding, and his high-speed spinning machinery for cotton mills. There are many more. Electricity supply as we know it to-day was largely fashioned by him. In England, in America, and practically all over the world, his name is a household word in engineering circles. Yet he was a singularly modest and retiring man. He never stood in the limelight or pushed himself forward for public recognition. Foreigners after meeting him sometimes asked, wonderingly, "Was that the great Ferranti?"

He was a fellow of the Royal Society, an honorary member and Faraday medallist of the Institution of Electrical Engineers, an honorary member of the American Institute of Electrical Engineers, and an honorary D.Sc. of the University of Manchester.

A. RUSSELL.

PROF. H. L. CALLENDAR, C.B.E., F.R.S.

IT is with deepest regret that we record the death of Hugh Longbourne Callendar, professor of physics at the Imperial College of Science and Technology. He was born in 1863, and died after a brief illness on Jan. 21 last. He leaves a widow and three sons.

Callendar received his early education at Marlborough at a time when little encouragement was given to a brilliant scholar to take up any form of experimental science, and he passed through the school on the classical side. In his first year at Trinity College, Cambridge, he received college prizes for classics and mathematics, obtained a first class in Part I. of the Classical Tripos of 1884, and was bracketed sixteenth Wrangler in the Mathematical Tripos of 1885. Afterwards, however, his whole career was devoted to the experimental branches of physical science, in which he developed a degree of skill and a *flair* for accurate work that left him without a rival.

Callendar's first work, on the platinum resistance thermometer, was communicated to the Royal Society in 1886, during which year he became a fellow of Trinity College, and his researches on temperature measurement were continued at the Cavendish Laboratory until 1893. After a brief interlude at the Royal Holloway College, Egham, he accepted appointment to a professorship of physics at McGill University, Montreal, remaining there for five years. During this period he developed his method of continuous electrical calorimetry, the first application being the measurements by his assistant Barnes on the specific heat of water. It was also at McGill that he first brought his knowledge to bear directly on the problems of engineering science, and in conjunction with Nicolson he made many valuable discoveries on the heat transmission and leakage losses from steam engine cylinders.

In 1898, Callendar returned to England as Quain professor of physics at University College, London, and in 1900 he first put forward his characteristic equation for an imperfect gas which has been so useful and satisfactory in representing the properties of steam. He accepted appointment as professor of physics at the Royal College of Science, now incorporated in the Imperial College of Science and Technology, in 1902, and still filled the chair at the time of his death. His long occupancy of this post has been crowded with work representing not only the developments of his early researches but also brilliant and vital investigations on many new lines to which he turned his attention.

Of the many services which Callendar has rendered to pure and applied science, it is difficult to say which should be placed first, but undoubtedly the most widespread utilisation of his researches lies in the applications of the platinum resistance thermometer. In this instrument, Callendar not only gave to the research worker a method of the highest order of accuracy for the measurement of temperature, but also gave to the engineer and metallurgist a convenient and

practicable method of heat regulation in industrial operations. To the perfection of the thermometer itself Callendar added the design of his automatic recorders and put the combination to many and varied uses. His equation for an imperfect gas with his measurements of the properties of steam are similarly of universal importance. It now seems so obvious that the values of the various properties of a vapour must be thermodynamically consistent with each other, yet of the many systems of steam tables in use throughout the world none possessed that vital attribute until Callendar showed the way. He was spared to put the crowning touch to the edifice which he had erected, and last year saw the publication of his experimental values for steam up to and beyond the critical pressure. He had long been dissatisfied with the usual presentation of conditions in the neighbourhood of the critical point, and his revelation of a differentiation in density and a latent heat beyond the temperature at which the meniscus vanishes came after a prolonged series of experiments which only he could have brought to a successful conclusion.

Space does not permit of a detailed reference to Callendar's work on the gas thermometer, the radio-balance, the re-determination of the specific heat of water, and the many other physical problems which he successfully attacked during his tenure in London. Concurrently with these researches, he conducted a series of investigations on engineering problems connected with steam turbines and internal combustion engines, and in 1925 and 1926 he published papers on dopes and detonation, in conjunction with the staff of the Air Ministry Laboratory, which represented most valuable advances in the elucidation of that important but obscure phenomenon. In all the major works which bear his name, he alone was responsible for every detail and every determination, and it may be that his most valuable contribution to science of the present day was the introduction of a new standard of accuracy for physical and engineering measurements. The elimination of every possible source of error and the very highest degree of consistency alone would satisfy him.

In his college lectures, Callendar was clear and concise, presenting his subject with logical sequence and perfect illustration. He took few holidays, and was most happy when allowed to pursue his individual research steadily and without interruption, yet no interrupter was ever received with anything but perfect courtesy. He was a good tennis player, and had won the Prince of Wales' Cup at Bisley for rifle-shooting. He had been interested in motoring from its earliest days. He was the inventor of a system of shorthand which is in fairly general use in some parts of the Colonies where older systems had not become firmly established prior to its advent. He had no great liking for public lectures or for committee work, but accepted in his course such duties as they called. He was for some years treasurer of the Physical Society of London, and was president in 1910–12. He was also president of Section A (Mathematical and Physical Science) of the British Association at the Dundee meeting in 1912. He was elected a fellow of the Royal Society in 1894, when only thirty years of age, and received the Rumford Medal in 1906. When the Physical Society of London established the Duddell Memorial Medal, to be awarded for the advancement of knowledge by the invention or design of scientific instruments, the name of the first recipient was a foregone conclusion and the medal was unanimously awarded to Callendar in 1924. He was a Hon. LL.D. of McGill University, and at least one British university was desirous to bestow the same honour upon him, but he declined to leave his college duties during the examination period.

It is pleasing to record that in the industrial world the work that Callendar did was valued, accepted, and used. His steam tables were officially adopted by the turbine manufacturers of Great Britain through the British and Electrical Allied Manufacturers' Association, and used for turbine tests and contracts, and his later work on high-pressure steam was supported and financed by the manufacturers' research association. He was awarded a Watt Medal by the Institution of Civil Engineers in 1898 for his work with Nicolson on the laws of condensation of steam, and received the Hawksley gold medal of the Institution of Mechanical Engineers in 1915 for his investigations into the flow of steam through nozzles and throttles, while in 1929 he was invited to deliver the Hawksley memorial lecture. He was made a C.B.E. in 1920 for his work for the Air Ministry and the Anti-Submarine Department of the Admiralty, but his most lasting memorial is the mark he has made on the science of accurate measurement. H. M.

WE regret to announce the following deaths:

Dr. A. J. Bigney, professor of zoology in Evansville College, Indiana, and president in 1915 of the Indiana Academy of Science, on Nov. 13, aged sixty-five years.

Prof. Ralph H. Curtiss, of Detroit Observatory and professor of astronomy at the University of Michigan, who was known for his work on stellar spectroscopy, on Dec. 25, aged forty-nine years.

Dr. Henry Wilson Hake, lecturer on chemistry and toxicology at Westminster Hospital Medical School, and consulting chemist, on Jan. 18, aged seventy-two years.

Prof. F. Neher, professor of organic chemistry since 1914 at Princeton University, who was known for work on the derivatives of halogenated ethers and esters, on Dec. 11, aged sixty-two years.

Prof. T. Brailsford Robertson, professor of biochemistry and general physiology in the University of Adelaide since 1920 and officer in charge of investigations on the nutrition of animals for the Commonwealth Council for Scientific and Industrial Research, on Jan. 25, aged forty-five years.

Rev. F. A. Tondorf, director of the seismological observatory and professor of physics at Georgetown University, Washington, on Nov. 29, aged fifty-nine years.

Sir Frank Warner, K.B.E., president in 1918–20 of the Textile Institute and a leading man in the silk industry of Great Britain, on Jan. 23, aged sixty-seven years.

News and Views.

IT was announced in the House of Commons on Jan. 23, in reply to a question, that the Sub-Committee of the Committee of Civil Research which is inquiring into the fishing industry has considered the problem of exploration for new fishing grounds, and, in view of the evidence put forward as to the need for systematic and well-planned investigations, has presented an Interim Report to the Committee of Civil Research. After considering this report, the Government has authorised the construction of a survey vessel at an estimated capital cost, including scientific equipment, of £80,000. The vessel is to be constructed and equipped by the Admiralty in a naval dockyard, and is to operate under the control and direction of the Hydrographer of the Navy. The Government proposes to ask Parliament to provide annually a sum of £34,000 to cover running expenses in each of the five years next succeeding the completion of this vessel. The Royal Research Ship *Discovery II.*, a description of which was given in NATURE on Nov. 23, 1929, p. 798, will be the pattern on which the new vessel will be constructed. Specially designed for ice navigation, and with a bunker capacity sufficient to enable her to steam 7800 miles at full speed and more than 10,000 miles at economic speed, such a ship should be able to accomplish much valuable work in arctic waters. *Discovery II.*, however, does not carry fishing gear of commercial dimensions, such as the sister ship will presumably employ if, as the British Trawlers' Federation suggests, the survey is accompanied by practical tests on a small scale of the fishing capacity of the grounds explored.

IT may occasion some surprise to those not acquainted with the present fisheries' situation that a great part of the area to be surveyed lies north of the Arctic Circle. The explanation of this rests upon the fact that every year the productive centre of our great sea fisheries tends to move farther north. The North Sea, once the most important fishing region, has yielded pride of place to Iceland, while increasing quantities of fish are now being landed from the still more northerly waters off Greenland and Bear Island. But with this movement northward the available charts and normal aids to navigation become fewer and less informative, so that our fishing pioneers labour under increasingly difficult and dangerous conditions. Thus it happens that substantial expenditure in time and money is incurred even to locate grounds previously visited. With capital expenditure mounting on account of the bigger ships needed, and running expenses becoming heavier due to the longer (and unproductive) journeys to and from the fishing grounds, the owners feel that they cannot undertake the desired survey work. Nor is it unreasonable, as the Sub-Committee of the Committee of Civil Research points out, for the industry to look to His Majesty's Government to provide, in respect of the new fishing grounds, the same type of information as was formerly supplied in regard to the nearer fishing grounds.

THE expedition of the British Museum to British Honduras to excavate Maya antiquities left England on Jan. 23. Owing to the inability of Capt. T. A. Joyce to accompany the expedition this season, it is under the command of Capt. E. L. Gruning. He is accompanied by Mr. Robert Ashton and Mr. E. H. Nelson. The expedition will again start from Punta Gorda, after a short stay at Belize, proceeding up the Mojo River to Pusilhá by canoe and motor tractor. Investigations will be resumed at the point at which they came to an end in 1929. Of the six large monoliths discovered last year, two remain to be deciphered and brought back. Further excavations will be made in the cave discovered last year. It will be remembered that the deposits in this cave, which yielded such a large store of remarkable pottery fragments, suggested that it had been used as a domestic rubbish shute by the inhabitants of a village site above. In addition to carrying further the work begun last season, Capt. Gruning proposes to examine a large number of ruins on the other bank of the river—an investigation which the topographical conditions suggest should provide much interesting material bearing upon cultural sequences and development in the area as a whole.

IT is announced that the material obtained by the British Honduras expedition in 1929 will shortly be on exhibition in the British Museum. Of this material a considerable proportion consisted of literally thousands of fragments of pottery which have been laboriously sorted, classified, and pieced together in the months which have elapsed since the members of the expedition returned to England. The results will well repay close study. The quality of the pottery is for the most part remarkable in the fineness both of its texture and finish, while the painted ornament, some of it unique in design, is beautiful in colour and style. The reconstruction of so many complete pieces from such a mass of heterogeneous sherds is a remarkable testimony to the skill and patience of the museum staff. The variety of style in form and decoration, which will be apparent when the material is seen as a whole, will serve to emphasise its importance as a clue to cultural development and in itself point to the need of a complete investigation of the site. Unfortunately, the British Museum itself has no funds for continuing the investigation on this or other sites in British Honduras. In previous years the expedition has been financed by donations, £200 a year having been contributed from a fund given to the Museum by Mr. John A. Roebling, an American benefactor. A similar amount has also been contributed by the Colony of British Honduras. In appealing for further contributions, the Director of the Museum points out that this is an opportunity for investigating a hitherto unknown culture within the British Empire and that it gives British archæologists a security of tenure not obtainable in the excavation of prehistoric sites in the Old World.

THE International Union for Pure and Applied Chemistry has now been reconstituted and brings in the German chemical societies under mutually acceptable conditions. Before this could be accomplished it was necessary for three of the leading German chemical societies to form a joint committee for international occasions. This Verband Deutscher Chemischer Vereine has been able to negotiate with the Union Internationale de la Chemie Pure et Appliquée. The new constitution and statutes are given in an article by Prof. Haber, president of the Verband D.C.V. in the *Zeitschrift für Angewandte Chemie* of Dec. 7. The new title is to be Union Internationale de Chimie, omitting the words pure and applied. The new statutes were agreed upon at Scheveningen in June 1929. If there are minor ambiguities in the German translation the French text is to be taken as official. German adhesion to the reconstituted Union is subject to the understanding that in its new constitution the International Research Council will not hinder the autonomy and free development of the Union. For German international chemical interests, communications may now be addressed to the secretary of the Verband D.C.V., Herrn Geheimrat Prof. Dr. Marckwald, Berlin, W.10, Sigismundstr. 4.

AT the general assembly of the International Research Council which was held at Brussels in July 1928, the executive committee of the Council was authorised to approve any modifications which the Unions might desire to make in their statutes so long as these did not conflict with the statutes of the Council. At the same meeting a committee was appointed to consider what modifications should be made in the statutes of the Council at the end of the present convention, which is in force up to Dec. 31, 1931. This committee met in Paris in September last, and its recommendations are now before the executive committee of the Research Council on which all the Unions are represented. The present general secretary of the International Research Council is Sir Henry Lyons, c/o The Royal Society, Burlington House, London, W.

To everyone interested in research the report for last year of the British Electrical and Allied Industries Research Association will be very encouraging. Not only has substantial progress been made in scientific researches on various important branches of the industry but also the finances of the Association are in a very satisfactory state. This was due to the prompt response made by electricity supply undertakings to an appeal for assistance, the automatic reduction of the Government grant being more than compensated by the new subscriptions. Valuable researches are being carried on for the Electricity Commission and for the Central Electricity Board. Special mention is made of the work done in elaborating methods for measuring the losses which occur in dielectrics when subjected to great electric stresses. Methods have been devised for the accurate measurement of the heat transferred from electric cables to the ducts containing them and to the heating of deeply buried cables. Researches on the losses in dielectrics at radio frequency are being carried out at the City and Guilds College and at the East London College. A very complete résumé of all the available information on the interference of power lines with telegraph, telephone, and radio circuits has been compiled. Experiments to clear up difficulties in the practical theory of 'interference' have also been made. Researches on the effect of earth returns under all conditions of working have received special attention as they have a very practical bearing on the working of the 'grid' system in Great Britain.

IN his Friday evening discourse on Jan. 24 at the Royal Institution on "Cellulose in the Light of the X-Rays", Sir William Bragg stated that when a fine pencil of X-rays traverses a fibre of any kind, cotton, hemp, ramie, jute, or such like, the mode of scattering indicates that cellulose is composed, in large part at least, of a mass of small crystals. That the same X-ray diagram is obtained from all fibres, even from animal cellulose, shows that we are dealing always with one and the same substance. It can further be deduced that there is in each crystal a periodicity parallel to the direction of the fibre; and this quantity can be determined exactly. The essential feature of the construction for cellulose suggested by both X-ray and by chemical evidence is the long chain of many links. The bonds that tie the links together are far stronger than those that tie the chain together; those that keep each of the cellulose chains together are as strong as the bonds in the diamond. Indeed, how could a thread carry a suspended weight unless there were great forces in play? But the side-to-side forces are far from being so strong. There seems ground to suppose that bundles of these long chains form 'crystallites', small crystalline masses of which the cellulose is largely composed. When the thread is stretched the X-rays show that these bundles go more and more into line. When the stress is too great the bundles begin to slide past one another, and if the force is too great, they let go and the thread breaks.

THE Council of the Institution of Electrical Engineers has made the ninth award of the Faraday Medal to Sir Ernest Rutherford. The Faraday Medal is awarded by the Council of the Institution not more frequently than once a year either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science without restriction as regards nationality, country of residence, or membership of the Institution.

DR. LOUIS A. BAUER, Director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington since the establishment of the Department on April 1, 1904, retired from this position on Jan. 1, last, with the title of director emeritus. Provision is being made whereby if his health permit he may carry on studies during the coming year as a research associate of the Institution. Mr. John A. Fleming, associated with Dr. Bauer as chief assistant in the Department of Terrestrial Magnetism since 1904, as assistant director for observational and administrative work during 1922 and 1923, and as assistant director in charge of operations since 1924,

continues in charge of the work of the Department with the title of acting director.

DR. FRIEDRICH KÜSTNER, director emeritus of the Bonn Observatory, has been made an honorary member of the American Astronomical Society, according to the provision that permits the election of one such member each year. Seven other living astronomers have been thus honoured: Dyson, Charlier, Turner, Baillaud, Eddington Wolf, and Deslandres. Küstner is best known for his detection, in 1888, of the variation of latitude, from observations made with a zenith telescope at Berlin. His two fundamental star catalogues, carried out with the meridian circle at Bonn, are unexcelled in accuracy and thoroughness, and are universally regarded as models for this class of work. With the comparatively modest equipment of the Bonn Observatory he has carried out a long series of determinations of radial velocities, and has shown that large telescopes are not necessary to secure results of a high order of accuracy. As a by-product of this work he was the first to determine the parallax of the sun by observing radial velocities of stars.

THE Rivers Memorial Medal for 1929 has been awarded by the council of the Royal Anthropological Institute to Mr. J. H. Hutton of the Indian Civil Service for his services to anthropology in the field in Assam. Mr. Hutton is the author of a monograph on "The Angami Nagas", published for the Assam Government, and a frequent contributor to scientific periodicals of notes on the ethnography of the Naga hill tribes. He has written the introductions to several of the monographs on the ethnography of the Nagas, published for the Government and written by members of the Civil Service and others, and it is largely owing to his energy and keen interest as director of ethnographical work, in which he has received the full support of the Government authorities, that a large amount of valuable information relating to the Naga tribes has been collected by himself and his subordinates in the course of their official duties.

THE Frazer Lecture, which was founded as a tribute to the work of Sir James Frazer, and is delivered biennally in turn in the universities with which he has been intimately connected—Oxford, Cambridge, Glasgow, and Liverpool—will be delivered this year at Oxford on Feb. 22. The lecturer is Dr. P. Rivet of Paris, the distinguished authority on the primitive cultures of America. The subject of the lecture will be "Civilisation américaine et océanienne". Dr. Rivet proposes to be in England for some days, and during his stay will deliver several lectures. On Feb. 20 he will lecture at the University of Bristol on "Les Grandes Civilisations Andéennes de la République de l'Equateur". On Feb. 25 he will be entertained at Cambridge and will deliver a lecture on "Les Races océaniennes en Amérique". On Feb. 27 he will be entertained at lunch in London by the Anglo-French Institute on behalf of Sir James and Lady Frazer, and in the evening of the same day will address the Institut Français, when his subject will be "Voyage au Mexique". The following week he will be at Manchester on Mar. 5, when he will again give an account of his travels in Mexico, and on Mar. 6 will read a paper before a joint meeting of the Anthropological Society of the University of London and the Royal Anthropological Institute at the London School of Economics at 8 P.M., his subject being "La Méthode historique et la Méthode évolutioniste en Ethnologie".

ON April 5–9, the American Society of Mechanical Engineers will celebrate its fiftieth anniversary, and Mr. W. H. Patchell and Mr. L. St. L. Pendred have been appointed to represent the Institution of Mechanical Engineers during the celebrations. It was on Feb. 16, 1880, in the office of the *American Machinist*, that the preliminary meeting of the Society was held, while the inaugural meeting took place on April 9, 1880, in the auditorium of the Stevens Institute of Technology at Hoboken. Prof. R. H. Thurston, as well known for his work for engineering education as for his researches and writings, was the first president, while his immediate successors included such as Leavitt, Sweet, Sellers, Babcock, and Towne, all pioneers in their respective spheres. The Stevens Institute is preparing an elaborate pageant depicting the early activities of the Society, a memorial service will be held at the Cathedral of St. John the Divine New York, and the subsequent proceedings will be held in Washington and will include a reception at White House. It is scarcely necessary to remind our readers that Mr. Hoover, the president of the United States, is himself an eminent mining engineer. A special feature of the proceedings will be the reading of sixteen papers bearing upon the influence of engineering upon civilisation, each of the papers summarising and evaluating the contributions of engineering to the cultural, social, economic and political life in one of the sixteen selected geographical divisions of the world.

TWO publications relating to the conference of Empire Meteorologists, held in London in August last, have been received. They refer to the agricultural section of the conference, which was arranged at the suggestion of the Empire Marketing Board, and was held under the chairmanship of Sir Napier Shaw. The first is simply a general report, running to sixteen pages, which gives details of the organisation of the section and of the resolutions arrived at in regard to future research in agricultural meteorology. It also contains various definitions that indicate which, in the opinion of the Conference, are the branches of agriculture particularly affected by weather or climate, and which are the subjects in the domains of the meteorologist and the agricultural research worker respectively. Among the resolutions may be noted one which was arrived at by a special committee, namely, that the month is too long a period for summarising, for publication, statistics of agricultural meteorology, and that the week should be used in preference.

THE second publication is a comparatively bulky volume running to more than three hundred pages, entitled "Papers and Discussions", giving the full substance of all the papers read at the Conference,

and of the discussions that followed them. Since each is followed in addition by a considerable bibliography of recent papers on that particular subject, it will be understood that this volume will prove very valuable to research workers throughout the Empire. The papers cover a wide field, which includes the influence of weather on crops, insect pests, the growth and fruiting of various fruit trees, etc., and the relationship between individual meteorological factors and the physiological processes of plant growth. There is a subject index that facilitates the extraction of particular items of information—a point of some importance to those practical farmers who may be sufficiently up-to-date in their methods to make use of information of this kind, but have little time for study.

THE ninth Annual Report of the Animal Breeding Research Department of the University of Edinburgh, by Prof. F. A. E. Crew, the director, indicates in small compass the great variety of investigations being undertaken by that institution. Apart from many researches in the physiology of sex and reproduction in birds and mammals, studies in subjects bearing more or less directly upon the problems of the farmer and breeder have touched upon all the common domestic animals of Great Britain. The new building which has been designed for the work of the Department is likely to be in full occupation early this year, and this should add greatly to the facilities of the many research workers who make use of the institution. Much has been gained by the attachment of the Imperial Bureau of Animal Genetics, and already the production is forecast of a quarterly bulletin on the breeding of domestic animals, especially of those within the Empire. Through the generosity of Mr. T. B. Macaulay, a new lectureship, with assistantships and maintenance, has been endowed, and a sum of £5000 has been offered for the purchase of a farm, designed to be equipped, stocked, and run as a fully functioning experimental station.

THE Report of the British Photographic Research Association for the year 1928–29 has recently been issued. It shows a continued and satisfactory progress, with a few changes in the personnel, as of course is to be expected. In the endeavour to estimate the value of investigational work, there is nothing more deceptive as a guide than the number of communications published, but we cannot help noticing that while three papers have been published, eleven " Private and Confidential Reports " have been circulated to members. We hope that the private and confidential section of the work will tend to diminish by the transfer of what might perhaps belong to it from some points of view, to the published section. Judging merely from some of the titles, it appears that this might well have been done during the past year.

A WIRELESS station for meteorological purposes has been erected in Franz Josef Land by the Soviet Government. A report of the expedition that was charged with the task is contained in a recent issue of the *Weekly News Bulletin* (No. 44) of the Soviet Society for Cultural Relations with Foreign Countries. The icebreaker *Sedov* left Archangel in July 1929. After some difficulty with pack-ice, Hooker Island was reached and a landing made. Newton Island and Cape Flora were then visited; eventually Scott Keltie Island to the north of Hooker Island was chosen for the station which was erected during August and put in charge of Prof. O. Schmidt. The *Sedov* pushed north along British Channel and visited Rudolf and Nansen Islands before returning to Europe. Geological and oceanographical results are promised.

OWING to unusual ice conditions in the Ross Sea, Admiral Byrd's American Antarctic expedition is in some danger of being held in the south for another winter. The *Times* reports that Admiral Byrd from his station near the Bay of Whales on the Ross Barrier has sent a wireless message asking for help. His ship, *City of New York*, is unable to force its way south through the pack-ice in order to pick up the expedition, and the assistance of Norwegian and British whalers, of which there are several in the Ross Sea, has been asked for. There seems to be about seventy-five miles of pack-ice lying some two hundred miles north of Admiral Byrd's camp, and offering an obstacle to his ship. Even if the expedition is unable to escape, there should be no danger of starvation, since abundant stores were landed last year and seals are numerous.

ENDERBY LAND in the Antarctic, lying on the Antarctic Circle in about long. 50° E., was discovered by Biscoe in 1831 and was not sighted again until December 1929. To the east of it in about the same latitude, in long. 60° E., Kemp Land, reported in 1833 by a sealer of that name, appears on the maps. Despatches to the *Times* show that the *Discovery* expedition of Sir Douglas Mawson and the *Norvegia* expedition of Capt. Riiser Larsen have both made considerable discoveries by sea and air and have met in the neighbourhood of Enderby Land. Sir Douglas Mawson has rediscovered Kemp Land and charted a new stretch of coast line to the east, which he has named MacRobertson Land. This evidently continues in the direction of Wilhelm Land and marks the continuity of land south of the Indian Ocean. The *Norvegia* on Dec. 22 found land between Kemp and Enderby Lands and charted the coast from long. 55° E. past Biscoe's Cape Ann to long. 43° E. Two weeks later Sir Douglas Mawson's expedition landed on a rocky coast in Enderby Land in lat. 66° 30′ S., long. 53° 30′ E., and found it to be built of ancient crystalline rocks, which proves the continuance of the Antarctic plateau into that area. Several lofty ice-free peaks were noted to the south-south-west. Many penguins and other sea birds were nesting along the coastal rocks. The frequency of huge tabular icebergs in the vicinity indicates the existence of tongues of the ice sheet not far off and probably to the east.

AMONG the recent acquisitions of the British Museum (Natural History) are the following: Prof. A. C. Seward, of Cambridge, has presented to the Department of Entomology a large collection of insect-galls and gall-makers from various localities in Great Britain. The plants upon which the galls were found

belong to some 28 genera and many of the specimens date back nearly to 1860. A correlation of these early records with present-day knowledge should therefore render it possible to form some idea of the way in which many species of gall-makers have extended their range. The recent Oxford University Expedition to British Guiana, for the purpose of studying life in the upper levels of a tropical forest, has handed over some 10,000 insects of various orders as part of the proceeds of its work. This collection derives special interest from having been made almost entirely in primitive jungle, as distinct from second growth forest; and from the fact that it includes many specimens obtained in trees at heights of 60-100 feet. The value that the common pheasant may sometimes possess from an agricultural point of view is illustrated by a series of 243 larvæ, or grubs, of the St. Mark's fly (*Bibio marci* Linn.) found in the crop of a hen pheasant, and presented by Mr. Mark Crapp, of Liskeard. The larvæ of the various species of *Bibio*, of which a number occur in Great Britain, live in colonies in the soil and do a certain amount of damage to the roots of grasses and other plants. As a further result of a collecting trip to South Africa last year, the mineral collection has received this month seven lots of material from South Africa. The collection of diatoms in the Department of Botany of the British Museum is both in historical value and in size the most important in existence. It has recently been enhanced by the bequest of about 12,500 slides which formed the collection of the late Wynne E. Baxter. This contains nearly 5000 slides from the famous collection of Frederick Kitton and a separate type collection arranged according to Van Heurck's treatise on the Diatomaceæ which was translated by Baxter in 1896.

SIR ALFRED YARROW has been elected an honorary member of the Institution of Civil Engineers.

IT is announced in the *Times* that the residuary estate of the late Mr. George de Arroyave Lopes, which is to go to the Zoological Society of London to form a De Arroyave Fund, will amount to more than £70,000. The Fund is to be applied for the upkeep and improvement of the Zoological Gardens and for the objects of the Society, the only conditions being that the Society hang the portrait of the testator's mother in its boardroom and maintain the family grave of Mr. de Lopes and his own grave.

THE Botanical Museum of the University of Zürich has voted the sum of 4000 Swiss francs, distributed over three years, towards a hydrobiological investigation of high-Alpine Swiss lakes. Candidates for grants should apply to the president of the Commission, Prof. Dr. Hans Schinz, Biberlinstrasse 15, Zürich 7, from whom the detailed programme of work may be obtained. Those of foreign nationality must have spent at least one year at a Swiss university in order to be eligible.

THE first photograph of the skull of *Sinanthropus* or Peking man recently discovered in China was exhibited by Prof. Elliot Smith at the meeting of the Royal Anthropological Institute on Jan. 21. Prof. Elliot Smith gave a brief demonstration of the photograph, pointing out the distinctive features to which attention has already been directed in the preliminary accounts of the skull which have appeared in our columns (Dec. 28, 1929, p. 973) and in the daily Press.

A JOINT meeting of the Royal Aeronautical Society and the Royal Meteorological Society will be held on Friday, Mar. 14, at 6.30 P.M., at which a lecture will be delivered by Dr. Fridtjof Nansen on "The Aims and Objects of the Aeroarctic". The meeting will be held in the Lecture Hall of the Institution of Electrical Engineers, Savoy Place, when Lord Thomson, Secretary of State for Air, will take the chair. After the lecture a dinner in honour of Prof. Nansen will be held at the Savoy Hotel.

AT the anniversary meeting of the Royal Anthropological Institute held on Jan. 28, the following officers and new members of council were elected for the year 1930–31:—*President:* Prof. J. L. Myres; *Hon. Secretary:* Mr. E. N. Fallaize; *Hon. Treasurer:* Mr. G. D. Hornblower; *Hon. Editor:* Mr. H. J. Braunholtz; *New Members of Council:* Miss G. Caton Thompson, Prof. W. Le Gros Clark, Dr. E. E. Evans-Pritchard, Mr. C. F. Hawkes, Mr. T. A. Joyce, Mr. A. Keiller, Lord Raglan, and Miss M. Tildesley.

WE have received No. 9 of the present series of the *Recueil des Travaux Chimiques des Pays-Bas*, published in August last, which is a complimentary number dedicated to Prof. A. F. Holleman on his seventieth birthday. The volume contains short papers by chemists of many countries and covering a wide range of subjects. Some of these give useful summaries of researches carried out by the authors over a series of years.

THE Ministry of Health has issued a memorandum (Memo. 122 C/T) on the costs at residential institutions for the treatment of tuberculosis. The table has been compiled on the same lines as in former years, and the information given should be of assistance to authorities in enabling them to check their expenditure and to take such steps as may be necessary to secure efficient and economical administration of their institutions.

WE have received *Technical Paper* No. 1 on Water Pollution Research, Department of Scientific and Industrial Research (London: H.M. Stationery Office, 6*d*. net), which deals with water softening, the base-exchange or zeolite process, and gives a summary of existing knowledge on this subject. The report has been prepared by Dr. A. R. Martin under the direction of Prof. G. T. Morgan, in the Department's Chemical Research Laboratory at Teddington.

THE semi-official Institute of Physical and Chemical Research of Tokyo has published a *Guide* which states that the object of the Institute is to assist industrial development by investigations in pure science. It occupies a site of nearly 40,000 square metres in Tokyo and has a capital of £570,000 derived largely from official sources. Its expenditure for the year ending Mar. 31, 1929, was £67,000, including an annual subsidy of £25,000 from Government. Its

staff consists of 256 directly engaged in investigations and about three hundred assistants, some of whom are engaged in experimental work in factories.

THE effects of the presence and absence of ultra-violet radiation have been the subject of experiment in the Aquarium of the New York Zoological Society. The tests were mostly carried out upon fishes. The detailed results are to be embodied in technical publications, but the Annual Report of the Director of the Aquarium states that the benefit of such irradiations under proper control, and the deleterious effect of their absence, were satisfactorily demonstrated. They include effects on health, fecundity, and growth of fishes and turtles of various species, as well as various minor effects upon representatives of other groups.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A headmaster of the Euclid Street Secondary School (Co-educational), Swindon—The Secretary to the Education Committee, 22 Regent Circus, Swindon (Feb. 8). A mathematics master and a chemistry master at the Acton Junior Technical School—J. E. Smart, Municipal Offices, Acton, W.3 (Feb. 8). A chief assistant under the Scottish Society for Research in Plant-Breeding, for research into virus disease of potatoes—The Secretary, Scottish Society for Research in Plant-Breeding, 3 George IV. Bridge, Edinburgh (Feb. 15). An oil seeds specialist in the Madras Agricultural Department—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Feb. 22). A senior and a junior geologist and a junior mineralogist in the department of the Geological Survey of Southern Rhodesia—The Secretary, Office of the High Commissioner for Southern Rhodesia, Crown House, Aldwych, W.C.2 (Mar. 31). A junior assistant under the Directorate of Ballistics Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. A temporary science mistress at the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E. A Secretary of Clifton College—The Secretary, Clifton College, Bristol.

Our Astronomical Column.

Astro-Photography of the Future.—The French journal, *L'Illustration* for Dec. 21 contains an article by Dr. G. W. Ritchey, late of the Yerkes and Mount Wilson Observatories, entitled, "De Nouveaux Firmaments Dévoilés par l'Astrophotographie". The article is enriched by some admirable large-scale reproductions of Dr. Ritchey's beautiful photographs of nebulæ taken with the 60-inch reflector of Mount Wilson Observatory, and is itself mainly a descriptive and speculative commentary on those photographs. Those who attended Dr. Ritchey's lectures in London a few years ago will remember with pleasure the numerous excellent lantern-slides with which they were illustrated. In the course of some reflections on the future possibilities of astro-photography, Dr. Ritchey remarks that, in spite of many examples of the achievement of the seemingly impossible, if to-day an experienced astronomer should venture to affirm that in a dozen years our knowledge of the universe would be enormously increased by the employment of photographic telescopes a hundred times more powerful than our present ones, he would be considered a heretic. Nevertheless, adds Dr. Ritchey, this is a possibility capable of immediate realisation. The super-telescopes which he foreshadows will give us large-scale photographs of thousands of spiral nebulæ in each stage of their development, with details of structure more delicate than those visible in existing photographs of the Andromeda nebula. By their comparison and classification there will gradually but surely become unveiled the story of the evolution of these immense stellar systems of space.

Washington Naval Observatory.—The Report of this observatory for 1929 has just come to hand. The eclipse expedition to Iloilo, Philippines, "was favoured with almost perfect weather conditions". Eighty photographs were taken, in addition to sketches and motion pictures taken from aeroplanes. Appreciation is expressed for the help given by Prof. W. A. Cogshall, of Indiana University, who joined the expedition.

The American Ephemeris, like the British Nautical Almanac, is introducing several changes in 1931. The mean equinox of the beginning of the year is used for the longitude and rectangular co-ordinates of the sun. In the prediction of eclipses the sun's longitude from Newcomb's tables is increased by $1{\cdot}5''$, and in the prediction of eclipses and occultations the moon's longitude is increased by $7''$. A new zodiacal catalogue is in progress of formation, which will contain all stars down to magnitude 7·0 that are liable to occultation. The 26-inch equatorial was used for observations of occultations of double stars and of the satellites of the planets; theoretical researches have also been made on the satellites of Mars and Saturn.

An interesting graph is given of sunspot activity since 1923, when the minimum occurred; the increase in activity in 1925 was very rapid; the highest maximum occurred before the middle of 1926; a second, but lower, maximum occurred just two years later. There is a decided depression between the two maxima; the curve resembles that of two sunspot cycles earlier.

Preparations are being made for observing Eros at its coming near approach, and many observations have been made of the stars selected as comparison stars.

Radial Motions of the *O*-type Stars.—Prof. C. D. Perrine discusses the radial motions of these stars in *Astr. Nach.*, 5672. After *correcting* for solar motion, he finds that the stars without emission lines show a decided positive velocity, while those with emission lines show negative velocity. The proper motions do not give any support to the view that the difference is in the space velocities of the stars, and he concludes that it arises from internal motions of expansion and contraction. He reached a similar conclusion concerning the planetary nebulæ in *Astr. Nach.*, 5670. He further suggests that the variable radial velocity which has been found in some of these stars, and ascribed to orbital motion, may be due to alternate expansion and contraction. This is held by many to be the explanation of the shift of spectral lines in the Cepheid variables. Prof. Perrine also suggests that the planetary nebulæ and the *O* and the *B* type stars form a progressive series of objects. This, however, does not seem to harmonise with his conclusion that all the planetary nebulæ are the relics of former novæ.

Research Items.

New Light on Drake's Voyage.—Two documents discovered by Miss E. G. R. Taylor in the British Museum throw much light on the plans of Drake's voyage of 1577. One of these documents, reproduced in part with an article in the *Geographical Journal* for January, is a draft plan for the voyage. Unfortunately, the document is mutilated, but careful examination reveals that the ships were to go and return by Magellan's Straits, that unknown shores not in the possession of any Christian prince were to be visited, and that the voyage was to be extended to 30°. Miss Taylor believes that the coast to be examined was not that of western America, which was already in Spanish possession between 40° S. and 35° N., but that of Terra Australis as shown on the Ortelius map of 1570. This coast ran north-west from the Strait of Magellan across the Pacific to the Moluccas. The second document is John Winter's report made on his return to England after losing touch with Drake in the South Seas. Winter's report shows that the westerly winds of the South Pacific made a westerly course impossible for him and no doubt encouraged Drake to turn north to harry the Spaniards and accept the alternative plan of seeking for the Strait of Anian. On his failure to find this strait in lat. 48° N., he turned to his original destination of the Moluccas.

Birds of the *Adventure* and *Beagle*.—When H.M.S. *Adventure* and *Beagle* were sent on a survey to the Strait of Magellan in 1826, the officers were instructed to collect rare, new, or interesting objects of natural history. Capt. King faithfully carried out the order, sending a first collection of 78 specimens of birds from Rio de Janeiro in 1827, and bringing with him on his return in 1830 a further collection, the numbers of which are unknown. These collections contained many new species of birds, and in view of the doubt which has existed as to the final resting-place of the type specimens, Surgeon Rear-Admiral J. H. Stenhouse has given short descriptions of the twenty-one specimens now in the Royal Scottish Museum in Edinburgh (*Scot. Nat.*, p. 181; 1929). Seven appear to be types or co-types of species described as new, but of these three have since been recognised as synonymous.

American Chipmunks.—The "North American Fauna" series of the Biological Survey of the U.S. Department of Agriculture continues its useful course with a revision of the chipmunks. Some impression of the amount of concentrated observation in present-day systematics may be gained from the fact that Arthur H. Howell, in writing this monograph, had at his disposal 1349 specimens of one genus with one species and 13,205 of another with 16 species. The result has been an increase in the number of geographical races recognised. Where *Tamias*, last revised in 1886, had two races, there are now five in a compact species, and where *Eutamias*, revised by Allen in 1890, had 23 forms, 60 have now been recognised. Something of the effect of diverse environmental conditions is suggested by the compactness of the eastern genus, and the extraordinary breaking up of the western genus into a multitude of forms. Interesting accounts are given of burrowing and nesting, food-storing and hibernation, breeding and feeding habits, and the descriptions of the various races are marked by a careful discrimination between summer and winter pelages. The chipmunks, particularly the western forms of the mountains and wildernesses, are of little economic significance, but they are familiar to most Americans, since they approach townships and cities with much more freedom than the native squirrel of Great Britain.

Crabs from Panama.—Mr. Lee Boone, member of the research staff of the Tropical Research Station of the New York Zoological Society, describes several very rare crabs in his paper "A Collection of Brachyuran Crustacea from the Bay of Panama and the Fresh Waters of the Canal Zone" (*Bulletin of the American Museum of Natural History*, Vol. 58, Art. 11, New York, 1929). The crabs were collected by Dr. Willard G. Van Name and his party, during a trip to the Isthmus of Panama and Pearl Islands in the spring of 1926, several hundreds being obtained, all of great interest. Among other rarities were two specimens of *Pitho quinquedentata*, one a female which is the first seen, as hitherto only two males were known, and a very fine example of the 'periscope-eyed' crab, *Euphylax dovii*, one of the Portunidæ. New records were obtained of the large fresh-water crab *Pseudothelphusa richmondi* showing an extended southern range. In this species the young, as in other Potamonidæ, are like the parent at birth, omitting all larval stages. In the present case the abbreviated life-history is probably correlated with the fact that in the dry season there is frequently no water in the stream beds in which the crab makes its home. The paper is illustrated by good photographs.

Studies on *Pectinatella*.—C. M. Brooks (*Proc. Acad. Nat. Sci. Philadelphia*, vol. 81, 1929) records observations on *Pectinatella magnifica*, the largest of the colonial fresh-water Polyzoa, the colonial mass of which sometimes exceeds two feet in diameter. This large gelatinous mass is hollow in the centre and there live flatworms, protozoa, snails, and crustacea; the flatworms are especially numerous and their eggs also are almost always to be found. The young flatworms appear about the time the statoblasts of *Pectinatella* break open and they devour the polypides in large numbers. The formation of statoblasts in *Pectinatella* begins in early autumn and continues until stopped by cold weather. The statoblasts are the chief means of distributing the species. When they first appear they are covered with a layer of jelly which prevents them clinging to the parent colony and they are readily dislodged and swept away by currents in the water, the zone of air-filled cells keeping the statoblast afloat. The covering of jelly soon decays and the hooks then exposed attach the statoblast to floating debris or to other objects. The statoblast develops steadily from the time it is fully formed until the polypide is produced, but the rate of development depends largely on the temperature. The author adds details of the anatomy of the polypide and states that scattered through the mass of food in the stomach are large nuclei, vacuolated and in degeneration, of cells which have migrated from the wall of the stomach possibly to aid in digestion.

Errors in Precise Levelling.—Apart from movements of the earth's crust, considerable errors in precise levelling may occur in several ways. Movements of the peg or bench mark during the night or between successive seasons is a source that cannot always be obviated. The small but appreciable error due to the use of wooden staves is to be prevented in the survey of India in future by the use of invar staves. Irregular refraction may be serious on a long continuous gradient. Lastly, the crossing of wide unbridged rivers involves a great loss of accuracy. In *Professional Papers*, No. 22, Survey of India,

Capt. G. Bomford discusses the errors connected with the last three sources. Recommendations are made for levelling across unbridged rivers in the primary net. Micrometer eyepieces should be used. Crossings should be made at a number of sites covering some miles of the banks. Sites below river junctions should be avoided. Directions are given for the use of sites in the middle of the river when the width renders this necessary. The paper discusses many points of great importance.

Properties of ß-Particles.—Collisions between β-particles and electrons or atomic nuclei are less easy to study than those of α-particles, but two recent investigations indicate that the correct laws of interaction have yet to be derived theoretically. One paper on this subject appears in a recent issue of the *Annalen der Physik* (No. 7), by O. Klemperer, and deals with the scattering of electrons with energies equivalent to 9 kilovolts and 18 kilovolts respectively. These were drawn from a hot filament, and examined by a Geiger electrical counter after passage through thin films of celluloid, beryllium, or aluminium; their angular distribution could not be reconciled with any of the usual laws which were tried. The other paper on the same subject is by E. J. Williams and F. R. Terroux, in the January issue of the *Proceedings of the Royal Society*, and is concerned with the tracks of rather faster β-particles in a Wilson cloud chamber. The results show that the classical theory gives only the order of magnitude both of the primary ionisation produced and of the frequency of production of branched tracks, the observed values being appreciably greater than the classical values, and following moreover a different law of variation with the velocity of the particle. The deflection of the β-particles in branch collisions does correspond, however, approximately to the momentum of the branch, contrary to the results found by Prof. C. T. R. Wilson for slower rays.

Radioactive Constants.—The question of the invariability of the decay constants of radioactive elements has been discussed by Mme. P. Curie in two papers in the September number of the *Journal de Physique*. In the first of these, commenting on a previous paper by L. Bogojavlensky (see NATURE, June 8, 1929, p. 872), she points out that very stringent precautions must be observed before the existence of any change in a constant with position on the earth's surface can be regarded as established. In the second, she describes briefly a number of experiments which have been made by her, or under her direction, in attempts to influence the normal course of radioactive disintegration. These have been made upon radium, radon, and polonium, by exposure to various types of radiation, and although some of the observations have still to be accounted for in detail, Mme. Curie believes that in no case do the results obtained furnish any certain evidence of departure from the generally accepted laws.

Electrons and Protons.—A theory of positive electricity has been put forward by Dr. P. A. M. Dirac in the January number of the *Proceedings of the Royal Society*. The relativity quantum theory of an electron leads to a wave equation which possesses solutions corresponding to negative energies—the energy of the electron of ordinary experiment being reckoned as positive—and although there are serious difficulties encountered in any immediate attempt to associate these negative states with protons, the existence of positive electricity can be predicted by a fairly direct line of argument. Since the stable states of an electron are those of lowest energy, all the electrons would tend to fall into the negative energy states—with emission of radiation—were it not for the Pauli exclusion principle, which prevents more than one electron from going to any one state. If, however, it is assumed that "there are so many electrons in the world that . . . all the states of negative energy are occupied except perhaps a few . . .", it may be supposed that the infinite number of electrons present in any volume will remain undetectable if uniformly distributed, and only the few 'holes', or missing states of negative energy will be amenable to observation. The step is then made of regarding these 'holes' as '*things of positive energy*' which are identified with the protons. A difficulty now arises in ordinary electromagnetic theory which apparently has to cope with the presence of negative electricity of infinite density; this is met by supposing that for ordinary purposes volume-charges must be measured by departures from a 'normal state of electrification', which is "the one where every electronic state of negative energy and none of positive energy is occupied." The problem of the large mass of the proton, as compared with that of the electron, is not discussed in detail, but a possible line of attack is indicated. Dr. Dirac has included the minimum of mathematical analysis in this paper, which can be followed in all essential points by anyone acquainted with the principles of the quantum theory.

Relation between Specific Heat and Temperature.—The *Atti della Pontificia Accademia delle Scienze* (*Nuovi Lincei*) for 1929 contains a communication by A. Denizot on a relation existing between specific heat and temperature. This author has previously directed attention to the formula, $c = a \log T$, according to which the specific heat is proportional to the logarithm of the absolute temperature. This expression is purely empirical and holds only for solid elements. If the values of a are plotted as ordinates against the atomic numbers N as abscissæ, a curve is obtained which is probably continuous under certain conditions and extends at one end to sodium (N 11) and lithium (N 3), and at the other to bismuth (N 83). There is, however, a gap left by the rare earth elements (N 56-72), and the values for boron, potassium, and nickel do not fall on the curve. Although no theoretical foundation exists for the curve, yet the marked agreement shown between the calculated and observed values of the specific heats for most of the elements seems to justify its use for calculating the specific heats of the rare earth elements, zirconium, etc., and also the atomic weights of the recently discovered elements, masurium, florentium, and rhenium.

Gibbs's Absorption Equation.—The December number of the *Journal of the American Chemical Society* contains a paper by McBain and Du Bois in which experiments on absorption in a liquid gas interface, supplementing those already noticed in NATURE (**120**, p. 819; 1927) are described. The results, it is claimed, support the conclusion arrived at in the earlier experiments that the surface of an ordinary solution is a unimolecular surface layer of orientated molecules which serve as points of support for the growth of chains of orientated molecules relatively far into the solution, such chains being evanescent, constantly breaking up as a result of thermal vibrations and constantly being replaced. The absorbed amount can be several times that which is compatible with the well-known equation of Gibbs. When a bubble passes through a solution of a simple substance, it can carry with it from two to eight times as much solute as is predicted by that equation, and from two to four times that which can be accommodated in a monomolecular film of closely packed, vertically orientated molecules. It is suggested that the use of Gibbs's equation to calculate absorption is artificial.

Insects Infesting Stored Cacao.[1]

THE Empire Marketing Board, in establishing a Committee on Infestation of Stored Products, has recognised the importance of dealing with the losses, occasioned both in transit and storage, by insect and other damage to a wide range of foodstuffs. By means of a series of grants made to the Imperial College of Science, the Board has enabled that institution to establish at Slough a special laboratory for stored products research. At present, attention is being mainly concentrated on the insect problems affecting cacao and dried fruits, and on fungus damage to cacao and copra. This work is under the general direction of Prof. J. W. Munro, and, as experience and facilities increase, it will doubtlessly embrace the study of other stored products in addition to those mentioned.

A report on insect infestation conditions prevailing in cacao stores in certain of the London docks and wharves, has been prepared for the Marketing Board's Committee on Stored Products by Messrs. J. W. Munro and W. S. Thompson. This shows that the prevention and control of the losses at present occasioned by cacao insects can only be attained by co-operation on the part of all concerned, since the infestation occurs throughout all stages of the cacao industry.

The problem of insect infestation in stored cacao has three main aspects, namely, (*a*) in the exporting country; (*b*) in wharves and warehouses of the importing country; and (*c*) in the cocoa and chocolate factories of the importing country. Cacao insects, for example, may enter the produce in the exporting country and their descendants eventually become transferred to chocolate factories far inland in the importing country. This may result in the occurrence of such insects in boxes of manufactured chocolates which may thus reach the consumer. Furthermore, certain cacao insects may affect other products stored in proximity to cacao and considerably reduce the value of such products.

The chief insects infesting cacao belong to three species. The moth *Ephestia elutella* Hb. is the most important, and its larvæ attack not only cacao-beans but also a great variety of other stored products, including biscuits, figs, chocolate, many kinds of grain, dried fruits, etc. It is, consequently, an insect of great economic significance and is very widely distributed. The larvæ of another small moth, *Corcyra cephalonica* Staint., are less harmful, since they only occur in small numbers. Like the preceding species, it has become widespread, although it was probably originally a pest of rice and has later taken to living on other products. The third species is the Anthribid beetle *Arœcercus fasciculatus* De G., the larvæ of which eat out the endosperm of the cacao beans. It is more especially an enemy of nutmegs, and only appears to be a serious cacao pest in the Gold Coast.

The results of Messrs. Munro and Thomson's investigations in London docks and warehouses show that the above species of insects are all found infesting the cacao on arrival from overseas. Cacao received from all exporting countries indicates that infestation takes place in those countries, and if remedial and control measures are to be effective they must be carried out at the sources of the trouble. In Great Britain it is obvious that whatever measures may be taken to clean up infected buildings, the latter will be liable to become reinfested from fresh cargoes constantly coming in from abroad.

Special attention is being given to the *Ephestia* in order to ascertain the life-cycle and behaviour of the insect under varying warehouse conditions. Its responses to heat, cold, fumigants, and other treatments are being tested, and various experiments have been, and are being, conducted relative to the de-infestation of affected buildings where consignments are housed. Under present conditions, clean cargoes stored in the warehouses are open to attack, and it is evident that the problem requires concerted action both by the exporting and importing countries. These facts are fully recognised, and there is little doubt that now investigations have been initiated, we can look forward to a solution of at least some of the outstanding problems. A. D. I.

[1] "Report on Insect Infestation of Stored Cacao." Prepared for the Empire Marketing Board's Committee on Infestation of Stored Products by J. W. Munro and W. S. Thomson. (London: H.M. Stationery Office, 1929.) 1*s*. 6*d*. net.

Field Strength in Broadcasting and Receiver Efficiency.

IN connexion with the field strength produced at various places by a broadcasting aerial, the paper on signal strength, by J. H. Reyner, published in the *Journal of the Institution of Electrical Engineers* for January, will be found of interest. Measurements were made in Cornwall of the field strength due to the broadcasting station 5XX at Daventry by means of a simple portable equipment consisting of a screened local oscillator and a sensitive micro-ammeter.

This equipment enabled the actual pressure in millivolts set up in a portable experimental aerial by the radiations from 5XX to be accurately measured. The effective height of the aerial being known, it was possible to convert the readings into field strength values in millivolts per metre.

The first set of readings was taken at selected points in Cornwall. The contour lines obtained seemed to indicate that the coast-line was exercising a marked absorbing effect, the field strength at Plymouth and Newquay being only about one-third that at Launceston. In the Perranporth district, the field strength on the coast-line was only about half that on the hill-top about two miles inland. The masts of the Bodmin beam station were visible from the hill-top and this suggested that it possibly cast a radio shadow. Subsequent experimental results afford strong evidence of this shadow.

The region of bad reception extends almost in a direct line from Daventry through Bodmin as far as Redruth, the distance between the latter two towns being about 25 miles. Surrounding this area of low signal strength is a ridge of good reception. For example, as one goes out towards the coast from Truro, the signal strength first rises on either side and then falls rapidly as the coast-line is approached. The Bodmin beam station was erected some years ago, but no complaint seems to have been made hitherto of any shadow being cast by it.

There is little doubt that with an accurate method of measuring how a radio receiving set fulfils its functions there would soon be a great improvement in their design. Now that the field intensity of the radiation from a broadcast station can be readily measured, simple methods of testing sets experimentally will most probably soon be devised.

In a paper read to the Institution of Electrical Engineers on Jan. 15, H. A. Thomas, of the National Physical Laboratory, gave a method of measuring the overall efficiency of a receiver. The ultimate aim of

all measurements of the constituent parts of a receiver is to obtain the relationship between the input supplied to it and the output it gives. This is the most important of the tests, but it is most difficult to obtain accurate results.

In making the tests use was made of the screened oscillator cabin at the laboratory, which has a mercury sealed trap-door, and the long copper ventilating pipes of which are provided with three copper gauze baffles which screen unwanted radiation completely. The apparatus described covers a wave-length range from 5 metres to 30,000 metres.

The results of tests on four receivers of widely different type are given. The experiments show that the overall properties of any receiver can be specified when the input voltage required at a definite modulation percentage to produce a definite standard output signal is known at all wave-lengths within the desired range. The selectivity of the receiver is the variation of the sensitivity in the neighbourhood of certain fixed wave-lengths. The distorting properties in the audio frequency stages have also to be measured. If it is only desired to determine the range of a receiver with respect to a particular transmitting station, two characteristic curves suffice. The work carried out has been done for the Radio Research Board.

Fishery Investigations off Iceland.

THE Scientific Report of the North-Western Area Committee for 1926–27 (Rapport Atlantique, secteur Nord-ouest, 1926–27. Conseil Permanent International pour l'Exploration de la Mer. May 1929), by Prof. Johs. Schmidt, contains four papers, the first and fourth on the haddock and plaice respectively, the second and third being shorter papers dealing with bottom faunas, by R. Spärk, and the age composition of the stock of cod in East Iceland fjords, by Árni Fridriksson.

Dr. Harold Thompson's work on the haddock, "General Features in the Biology of the Haddock (*Gadus œglefinus* L.) in Icelandic Waters in the Period 1903–1926", and Dr. Å. Vedel Tåning's "Plaice Investigations in Icelandic Waters", are both of great importance. These works deal with the stock on the feeding grounds, age composition, rate of growth, and various biological considerations. Both fishes inhabit natural sub-areas of the Icelandic plateau. For the haddock, two main regions are differentiated, one to the north and east where the coasts are exposed to the polar current, and one to the south and west which is exposed to the warmer Atlantic stream, spawning taking place in this warmer region with a maximum in April, the fish being larger at the same age than those from the north-east. It is, however, only the bottom stages of the haddock which are here described, as the eggs and larval forms have been fully dealt with by Johs. Schmidt (*Cons. Internat. Rapp. et Proc. Verb.*, vol. 10, 1902–7, No. 4). The otter trawl is shown to be efficacious and trustworthy for sampling the haddock shoals. Growth rates are calculated from the annual zones in the scales.

It is assumed, and the assumption is confirmed by biological evidence, that the Icelandic haddock are a self-contained stock cut off from interchange with those of other grounds by deep water. The first-year haddock, the product of the spawning season, like those in the North Sea, probably remain in fairly deep water, later moving nearer the coast for feeding. Except the Faroe haddock, those from Iceland grow more rapidly than any in the East Atlantic. It is thought that the feeding conditions probably account for this, although so far only a beginning has been made in research of this kind. Sand-eel is shown to be largely eaten and rapid growth is then effected. The Icelandic haddock spawn at an age of at least one year older than is the case with those from the North Sea.

Dr. Å. Vedel Tåning's work on the plaice deals with spawning and larval forms as well as with the adults. Spawning continues from February until May with a maximum in March and April and takes place chiefly in the warmer water of the south and west, the late spawning having a great influence on the rate of growth. The maximal growth is found on the western part of the south coast. There is a marked decline in the growth along the south coast round to the east coast coinciding with the fall of temperature. Temperature and length of summer are shown to be of great importance for the rate of growth in the plaice in Icelandic waters, and probably these factors influence the rate of growth of plaice generally. Unlike the haddock, the Icelandic plaice has a higher total number of vertebræ than other known forms, and also varies much in this respect in the Icelandic area itself.

University and Educational Intelligence.

CAMBRIDGE.—The Gordon Wigan Prize in chemistry for 1929 has been awarded to C. G. Lyons, Trinity Hall, for a dissertation entitled "Thin Films, their Properties and Structure".

Applications for the John Lucas Walker studentship, the holder of which has to devote himself to original research in pathology, are invited and should be sent before July 1 to the professor of pathology. The studentship is of the annual value of £300 and is tenable for three years. Applications for the Gwynaeth Pretty studentship, the holder of which has to devote himself to original research in the etiology, pathology, and treatment of disease, are also invited; they should be sent before July 1 to the professor of pathology. The studentship is of the annual value of £200 and is tenable for three years.

The managers of the Nita King Research scholarship for the encouragement of original research in the etiology, pathology, and prevention of fevers, invite applications from candidates; these should reach the professor of pathology before Feb. 28.

The governing body of Emmanuel College invites applications for a research studentship which will be awarded in July next. Applications (with evidence for a proposed course of research) must reach the Master of Emmanuel College not later than June 30. Preference will be given to candidates who have already completed one but not more than two years of research. The studentship has a maximum annual value of £150, and is normally held for two years.

LEEDS.—M. G. B. Howarth, senior research assistant on the staff of the Joint Research Committee of the Institution of Gas Engineers and the University of Leeds, has been appointed chief chemist to the Newcastle-upon-Tyne and Gateshead Gas Company. Mr. Howarth was awarded a University scholarship in 1920, and since then has had varied research experience on the works and in the laboratory at Birmingham and Leeds, dealing with blue and carburetted water gas plants, waste heat boilers, aeration of burners, and the products of combustion of gas appliances.

'PARENT-TEACHER' associations have been at work in the United States for more than thirty years, striving to bring about closer co-operation between home and school. No similar movement elsewhere

has attained the volume represented by the membership roll of a million and a half of the National Congress of Parents and Teachers of the United States, entirely independent, as it is, of State direction. In 1927, however, sufficiently widespread interest had been aroused in other countries to justify the organisation of an International Federation of Home and School. This was accomplished at Toronto in connexion with a meeting of the World Federation of Education Associations, the declared object being "to bring together for conference and co-operation all those agencies which concern themselves with the care and training of children in home, school, and community; and with the education of parents to meet these responsibilities". Twenty-two countries are represented on the board of management, the first action of which was to undertake a survey of the present situation. Some of the salient features revealed by reports received from thirty-three countries are recorded in an article by the president of the Federation, published in the November issue of *School Life*, the organ of the United States Office of Education. From this we learn that next in size and seniority to the American Congress of Parents and Teachers is a West Australian federation, which concerns itself specially with the provision of playing fields and other matters of importance to the physical welfare of school children. The movement was introduced into Canada in 1916 and quickly spread from Ontario to other provinces. Here, too, special emphasis is laid upon improvement of school conditions affecting the health of pupils. In almost every country of Europe systematic attempts are, it is found, in progress to establish conscious community of purpose and co-operation in home and school.

THE International Federation of University Women celebrated its tenth anniversary and held its fifth conference at Geneva last August. Some five hundred delegates from thirty-one national associations were present. Among the matters discussed in the course of the proceedings, which lasted seven days, was "The Value of Research". Madame Ramart-Lucas from the Sorbonne contributed a survey of "The Creative Effort of the Chemists", and Dr. Luise Lammert, who, after a year of study in Australia as holder of one of the Australian university women's fellowships, is working at the Leipzig Meteorological Institute, gave an account of solar radiation observations, including her own researches in Australia. The Federation's project for the establishment of international fellowships has not hitherto met with the encouragement it seems to deserve, the capital, contributed by eighteen associations, amounting to less than £4000, whereas the sum required to endow one fellowship is £5000. The Carnegie Endowment for the Promotion of Peace has marked its appreciation of the Federation's efforts by granting 5000 dollars to be used for travelling expenses. Among resolutions adopted at the conference was one providing for assistance in the translation of scientific works. A scheme was formulated for utilising and co-ordinating for this purpose the linguistic and technical knowledge of the Federation's members. In that part of the conference report relating to the work of the various national associations, their activities are described under the following heads: encouragement of independent research work, stimulation of interest in national and municipal policy, social service, intelligence service, assistance towards finding employment, facilities for social intercourse, educational and cultural work, and other activities. The headquarters of the Federation are at Crosby Hall, Cheyne Walk, London, S.W.3.

Historic Natural Events.

Feb. 2, 1282. Severe Winter.—Stow records that "From Christmas to the Purification of our Lady [Feb. 2] there was such a frost and snow as no man living could remember the like: wherethrough five arches of London Bridge were borne downe and carried away by the streame; and the like hapned to many other bridges in England. And, not long after, men passed over the Thames between Westminster and Lambeth dryshod." The frozen Thames was used as a highway, and the damage to the bridges was caused by the break up of the ice. The winter was also severe in Europe, and at the end of February such heavy snow fell in Austria that many houses could scarcely be seen. The melting of the snows caused great floods, and Paris was inundated by the Seine.

Feb. 2, 1887. Drought.—In January 1887 a great area of high pressure lay over Europe, and in February this moved westward over England. In London a drought began on Feb. 2, the first of 17 consecutive days without rain. In March the anticylcone moved still farther west, and until the end of August with few interruptions pressure remained abnormally high over the Atlantic west of Ireland. The year 1887 was consequently very dry; over the British Isles as a whole the rainfall was the smallest on record since at least the beginning of the nineteenth century, though in south-east England the drought was less severe than in 1921. The level of Lake Derwentwater fell lower than ever previously recorded; at Maresfield, Sussex, threepence a pail was paid for water, and at Langho, near Blackburn, water was brought in cans like milk and strictly rationed by the station-master.

Feb. 4, 1579. Snow.—Holinshed records that on Feb. 4, and the following night "fell such abundance of snow, that . . . in the morning, the same snow was found in London to lie two foot deep in the shallowest and otherwise, being driven by the wind very boisterous in the northeast, banks one ell or a yard and a half deep. In the which drifts of snow, far deeper in the country, many cattle, and some men and women were overwhelmed and lost. It snowed till the eighth day of that month, and freezed till the tenth, and then followed a thaw with continual rain a long time after, which caused such high waters, and great floods, that the marshes and low grounds being drowned for the time, and the water of the Thames rose so high into Westminster Hall, that after the fall thereof, some fishes were found to remain in the said hall."

Feb. 5, 1783. Earthquake.—The series of great Calabrian earthquakes beginning on Feb. 5 are of interest as the first to be carefully studied. There were six great shocks, the strongest being those of Feb. 5 and Mar. 28. The meizoseismal areas were all small, one town being ruined, while another a few miles away escaped damage. Besides being shallow, the focus oscillated to and fro over a distance of 60 miles from Messina to Girifalco. By Oct. 1786, 1186 after-shocks were felt at Monteleone.

Feb. 5 and 7, 1892. Low Temperature.—The lowest temperature ever recorded on the earth's surface was −90° F. at Verkhoyansk, Siberia, 200 miles from the mouth of the Lena River.

Feb. 7, 1921. Drought.—From February to October 1921 barometric pressure was above normal over the whole of Europe except the north of Scandinavia, over the United States, and most of Asia. These nine months, and the year as a whole, were exceptionally dry over a large part of the northern hemisphere. In London, the drought began on Feb. 7, and no

appreciable rain fell until Feb. 25. The year was not especially dry in Scotland and Ireland, but in England it was the driest since at least the beginning of the nineteenth century; in parts of east Kent the rainfall was less than half the average, and at Margate the total rainfall for the year was only 10 inches. In July the flow of the River Thames at Teddington fell to less than one-third of the normal July flow. In western Europe the drought was equally severe; in Belgium and northern France it was without precedent in historic times, Switzerland and northern Italy suffered severely, and in the Trentino the water of one of the lakes fell so low that a small island appeared for the first time since the great drought of 1806. In Russia the harvest failed, causing widespread famine and many deaths.

Feb. 8, 1843. Earthquake.—By the destructive earthquake of Guadeloupe, Pointe-à-Pitre, the principal town and port of the island, was reduced to a heap of ruins. The shock was felt in Barbados and along the coast of British Guiana, so that the disturbed area must have contained at least one million square miles. The wharves of Pointe-à-Pitre subsided throughout their length, in one place by about a foot.

Societies and Academies.

LONDON.

Royal Society, Jan. 23.—**Lord Rayleigh**: Normal atmospheric dispersion as the cause of the 'Green flash' at sunset, with illustrative experiments (see NATURE, Jan. 25, p. 144).—**F. W. Aston**: The photometry of mass-spectra and the atomic weights of krypton, xenon, and mercury. The relative abundance of isotopes can be deduced from the photometry of their lines in mass-spectra with sufficient accuracy for a preliminary survey. Numerical results are given for the six isotopes of krypton, nine isotopes of xenon, and seven isotopes of mercury. The 'isotopic moment' of an element is defined and its value given for these three elements. Atomic weight of mercury determined from the abundance results is in good accordance with the accepted value; those for krypton and xenon suggest that those deduced from the densities are about 1 per cent too low.—**P. A. M. Dirac**: A theory of electrons and protons. It is proposed that nearly all the states of negative energy are occupied, so that an electron in a state of positive energy cannot jump into them, by the exclusion principle. A state of negative energy that is not occupied may then be identified as a proton, as it will appear to have a positive energy and positive charge (see also p. 182).—**R. V. Southwell** and **L. Chitty**: On the problem of hydro-dynamic stability (1). The paper deals with stability of steady shearing motion in a viscous fluid. The method of normal co-ordinates appears to be satisfactory for infinitesimal disturbances. Within the range of 'Reynolds' number' covered, all normal disturbances have a decreasing time-factor, which depends on Reynolds' number in an extremely complicated way. The looped diagrams representing this dependence have no counterpart in ordinary problems of vibration theory.—**T. E. Stern**: Some remarks on the conduction of electricity in metals and upon allied phenomena. There are two classes of phenomena: (1) Those associated with the flow of electricity in closed circuits, to be investigated only by making use of transport theories; and (2) those associated with insulated conductors, to be investigated by general equilibrium theories. Various consequences of this difference—such as difference between cooling effects of evaporation of electrons from insulated and from uninsulated conductors—are investigated. Special phenomena arising in case of non-isotropic conductors are considered.—**A. Harvey**: The Zeeman effect in the band spectrum of helium (2). Estimates are given of magnitudes of (unresolved) Zeeman patterns in He_2 bands of type $^3D \rightarrow 2P\ ^3\Pi$. Effects are widely different for different initial terms $D\epsilon$, $D\pi$, and $D\Delta$, and appear to be closely related to uncoupling of electronic orbital angular momentum L from the inter-nuclear axis. A few observations on the singlet system were possible, results being generally similar to those for the triplet system.

GENEVA.

Society of Physics and Natural History, Oct. 24.—**T. Tommasina**: Experimental proof, in the heat radiation, of dynamic ultra-red rays. A double radiometer, revolving in opposite directions, is placed under a triple glass wall, in order to eliminate the direct action of heat. With a previously heated pad of cloth, or piece of wood charcoal, coke, or anthracite, there is an immediate rotation of the vanes. The author concludes from this that heated black bodies emit penetrating radiations.—**R. Matthey**: The chromosomes of saurians. The author has established the chromosome formula of ten species, representing eight families. A classification based on the chromosome formula fits in fairly well with modern systematics.—**E. Briner** and **A. Rivier**: The chemical action of electric discharges; the influence of the electrodes on the production of nitric oxide by the arc. Relying upon electronic theories, more especially on the laws regulating the electronic emission of solid bodies, the authors have realised, using appropriate material for the electrodes, marked improvements in the chemical yield of the electric arc in the fixation of nitrogen in the form of oxide.

Nov. 7.—**E. Cherbuliez** and **St. Ansbacher**: The physiological presence of copper in certain organs in the higher animals. A very exact method of estimation has shown the presence of copper in the organs of the higher animals. The liver and the spleen are much richer in this element in the newly born than in the adult; in the tuberculous guinea-pig the proportion of copper is increased in the liver and reduced in the spleen. These facts suggest a hitherto unsuspected physiological rôle for copper.—**G. Tiercy**: Generalisation of the Plantamour method for the measurement of the error of compensation of chronometers. The Plantamour method, applied at Teddington, Besançon, and Geneva, has been proposed by Plantamour for the case of three thermal periods. The author shows that it also applies in a very simple manner to the case of n periods.—**R. Wavre**: Complement to the theory of planetary figures. The author, by a rigorous and short method, had obtained a system of theoretical relations giving the free surface of fluid stars in slow rotation. Wishing to pass from theory to practice, he puts these relations in a form directly utilisable in geodesy, making evident the quantities physically measurable. The results obtained suggest that an agreement is possible between the geodesic measurements and the value of a certain constant furnished by the precession of the equinoxes.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 19).—**E. Selivanova**: *Coelanthus subtilis* (Tratt.) Seidel. This grass, known hitherto from a few localities in western Europe, Siberia, and North America, has been found by the author near the river Volchov, in the Novgorod province of European Russia.—**P. Piatkov**: Botanical and soil investigations on Novaya Zemlya, in the area of the polar geophysical observatory 'Matochkin Shar', during 1927–1928. A brief preliminary account of the investigations.—**A. N. Labuntsov**: The deposits of molybdenite in the Khibin tundra. A description of the deposits is presented.

Official Publications Received.

BRITISH.

South Australia: Department of Mines. Mining Review for the Half year ended June 30th, 1929. (No. 50.) Pp. 105+4 plates. (Adelaide: Harrison Weir.)

The Medical and Scientific Archives of the Adelaide Hospital. No. 8 (for the Year 1928). Pp. 81. (Adelaide: Harrison Weir.)

Institute of Industrial Administration. Examination Scheme for the Diploma of Industrial Administration. December 1929 edition. Pp. 16. (London.)

Department of Agriculture, New South Wales. Veterinary Research Report, 1927–28. (No. 5.) Pp. 124+12 plates. (Sydney, N.S.W.: Alfred James Kent.)

Transactions of the Mining and Geological Institute of India. Vol. 24, Part 2, December 1929. Pp. 79-222+plates 4-14. (Calcutta.) 4 rupees.

Memoirs of the Indian Museum. Vol. 9, No. 4: An Aid to the Study of Hamilton Buchanan's "Gangetic Fishes". By Dr. Sunder Lal Hora. Pp. 169-192+plates 13-23. 2.10 rupees; 4*s*. 9*d*. Vol. 10: The Copepoda of Indian Seas—Calanoida. By Lieut.-Col. R. B. Seymour Sewell. Pp. 221. 8.2 rupees; 13*s*. 9*d*. (Calcutta: Zoological Survey of India.)

Records of the Indian Museum. Vol. 31, Part 4, December 1929. Pp. 259-334+plates 12-15. (Calcutta: Zoological Survey of India.) 2.12 rupees; 5*s*.

River Moriston. Report on River Flow, July to September 1929. By W. N. McClean. (River Flow Records, Ness Basin.) Pp. 4+3 tables. (London: River Flow Records.) 1*s*. 6*d*.

Torquay Natural History Society. Transactions and Proceedings for the Year 1928–9. Vol. 5, Part 3. Pp. 175-258+3 plates. (Torquay.)

Journal of the Royal Microscopical Society. Series 3, Vol. 49, Part 4, December 1929. Pp. xvi+319-466. (London.) 10*s*. net.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1207 (Ae. 368): Wing Flutter as Influenced by the Mobility of the Fuselage. By R. A. Frazer and W. J. Duncan. (T. 2677: T. 2741: T. 2746.) Pp. 33. (London: H.M. Stationery Office.) 1*s*. 3*d*. net.

University College and University College Hospital Medical School, London. The Second Rickman Godlee Lecture. Natural History: the Pleasure and Purpose of Observation. Delivered by the Rt. Hon. the Viscount Grey of Fallodon in the Great Hall of the College on Thursday, 7th November 1929. Pp. 32. (London: University College Publications Secretary.) 1*s*.

The Gardens' Bulletin, Straits Settlements. Vol. 6, Part 1, December: On Chinese Medicine; Drugs of Chinese Pharmacies in Malaya. By Dr. David Hooper. Pp. 163. (Singapore: Botanic Gardens.) 2.50 dollars.

Government of India: Department of Industries and Labour (Public Works Branch). Irrigation in India: Review for 1927–28. Pp. 37. (Calcutta: Government of India Central Publication Branch.) 14 annas; 1*s*. 6*d*.

FOREIGN.

Proceedings of the United States National Museum. Vol. 76, Art. 11: Revision of the Two-winged Flies of the Genus Coelopa Meigen in North America. By J. M. Aldrich. (No. 2808.) Pp. 6. Vol. 76, Art. 12: Two New Species of Trematodes of the Genus Parametorchis from Fur-bearing Animals. By Emmett W. Price. (No. 2809.) Pp. 5. Vol. 76, Art. 15: New Genera and Species of Muscoid Flies. By J. M. Aldrich. (No. 2812.) Pp. 13. Vol. 76, Art 20: Notes on the Muscoid Flies of the Genera Opelousia and Opsodexia with the Description of Three New Species. By H. J. Reinhard. (No. 2817.) Pp. 9. (Washington, D.C.: Government Printing Office.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 51: Air Flow through Suction Valve of Conical Seat. Part 2: Analytical Investigation. By Keikiti Tanaka. Pp. 361-424. 0.70 yen. No. 52: Application of the Inverse Wiedemann Effect to Torque Measurements and to Torque Variation Recordings. By Tatuo Kobayasi, assisted by Kinmatu Simamura and Tatuo Koyama. Pp. 425-445. 0.35 yen. (Tôkyô: Koseikai Publishing House.)

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin". Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 11, Livraison 2, Novembre 1929. Pp. 155-300. (Buitenzorg: Archipel Drukkerij.) 2.50 f.

Comité International des Poids et Mesures. Procès-verbaux des séances. Deuxième série, Tome 13, Session de 1929. Pp. vii+287. (Paris: Gauthier-Villars et Cie.)

Rapport annuel sur l'état de l'Observatoire de Paris pour l'année 1928. Par M. Deslandres. Pp. 46. (Paris.)

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau Central de Magnétisme terrestre. Publiées par les soins de Prof. Ch. Maurain. Tome 7. Pp. iv+213. (Paris: Les Presses universitaires de France.)

Comité National Français de Géodésie et de Géophysique: Section de Magnétisme et Électricité terrestres. Nouveau réseau magnétique de la France au 1er janvier 1924. (Extrait des Annales de l'Institut de Physique du Globe de l'Université de Paris, tome 7.) Pp. 45. (Paris: Les Presses universitaires de France.)

Ministry of Public Works, Egypt: Physical Department. Meteorological Report for the Year 1923. Pp. xiii+168. (Cairo: Government Press.) 40 P.T.

Journal of the Faculty of Science, Imperial University of Tokyo. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 1, Part 12. Pp. 439-480+plates 36-39. 1.20 yen. Section 4: Zoology. Vol. 2, Part 2. Pp. 51-139+plates 9-11. 2.30 yen. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 2, Part 9. Pp. 369-398+plates 71-76. 1.10 yen. Vol. 3, Part 1. Pp. vi+28+4 plates. 1.00 yen. Vol. 3, Part 2. Pp. 29-129. 1.90 yen. (Tokyo: Maruzen Co., Ltd.)

Smithsonian Institution: United States National Museum. Bulletin 100: Contributions to the Biology of the Philippine Archipelago and Adjacent Regions. Bryozoa of the Philippine Region. By Ferdinand Canu and Ray S. Bassler. Pp. xi+685+94 plates. (Washington, D.C.: Government Printing Office.) 1.75 dollars.

Annual Report of the Naval Observatory for the Fiscal Year 1929. (Appendix No. 2 to Annual Report of the Chief of the Bureau of Navigation, 1929.) Pp. iii + 37. (Washington, D.C.: Government Printing Office.)

United States Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 3, No. 5, November 1929. Pp. 619-827. (Washington, D.C.: Government Printing Office.)

The University of Chicago. Publications of the Yerkes Observatory, Vol. 7, Part 1: Radial Velocities of 500 Stars of Spectral Class A. By Edwin B. Frost, Storrs B. Barrett and Otto Struve. Pp. vii+79. (Chicago: University of Chicago Press; London: Cambridge University Press.)

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft. 110 Jahresversammlung vom 29 August bis 1 September 1929 in Davos. Pp. 144+236+44. (Aarau: H. R. Sauerländer et Cie.)

CATALOGUES.

Catalogue of Scientific Books and Publications of Learned Societies. (No. 540.) Pp. 110. (Cambridge: W. Heffer and Sons, Ltd.)

Watsons Microscope Record. No. 19, January. Pp. 32. (London: W. Watson and Sons, Ltd.)

The "Sanbro" Laboratory Oven. Pp. 8. (London: Brown and Son, Ltd.)

Diary of Societies.

FRIDAY, JANUARY 31.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall), at 3.30.—W. S. Burn: High-powered Oil Engines for Land Purposes.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4.30.—Seismic Methods in Surveying: Prof. A. O. Rankine, Dr. H. Jeffreys, Capt. Shaw, R. S. Whipple, F. J. W. Whipple. Chairman, Prof. H. H. Turner.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. W. S. Handley: The Papilloma and its Menace.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—R. R. Poole: Practical Television.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section), at 7.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (Joint Meeting) (at Newcastle-upon-Tyne), at 7.15.—W. G. Thompson: The Electrical Propulsion of Ships.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section, jointly with other Chemical Societies of Glasgow) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Prof. I. M. Heilbron: Our Present Knowledge of the Fat-soluble Vitamins A and D.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—F. Onions: Superheating.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Lord Rayleigh: Iridescent Colour in Nature.

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub-Centre).

SATURDAY, FEBRUARY 1.

BRITISH MYCOLOGICAL SOCIETY (at University College), at 11 A.M.—D. B. Barnes: Induced Variations in *Thamnidium elegans*.—Prof. W. Brown: Investigations on the Physico-chemical Basis of Disease Resistance.—Dr. I. Reichert: Infection of *Ægilops* with *Tilletia*.—Dr. G. Samuel: The Generic Names *Alternaria* and *Macrosporium*.—Dr. H. S. Vasudeva: The Effect of one Organism in Reducing the Virulence of Another.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3.—Annual Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. R. W. Chambers: Sir Thomas More and his Friends (2).

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—The Westland Wapiti in Service.

MONDAY, FEBRUARY 3.

ROYAL SOCIETY, EDINBURGH, at 4.30.—R. W. Wrigley: On Changes of Rock Temperatures and Irregularities of the Earth's Rotation.—S. Williams: The Morphology of *Trichomanes aphlebioides* Christ., with Special Reference to the Aphlebioid Leaves.—J. S. Patel: On the Existence of a Kyogenic Substance in the Corpus Luteum.—Pius Koller: Genetic Studies of the A and B Races of *Drosophila obscura*.—Prof. F. A. E. Crew and Dr. L. Mirskaia: Maturity in Albino and Coloured Mice.—A. Mozley: Report of the Jasper Park Lakes Investigations, 1924–26. The Mollusca of Jasper Park.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Rev. Dr. W. M. Christie: Jew and Arab in Palestine.

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

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. G. Keynes: The Radium Treatment of Carcinoma of the Breast.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—W. M. Beckett: Presidential Address.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—Miss Evelyn Lawrence: An Investigation into the Relation between Intelligence and Inheritance.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—H. G. S. Peck and others: Discussion on Maintenance of Telephone Plant.

UNIVERSITY OF BIRMINGHAM MEDICAL SOCIETY, at 8.—Prof. J. C. Brash: The Surgeon Anatomist and the History of Anatomy (William Haslam Oration).

ROYAL SOCIETY OF ARTS, at 8.—H. J. L. Wright: Three Master Etchers: Rembrandt, Meryon, Whistler (Cantor Lectures) (3).

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Institution of Mechanical Engineers), at 8.—Dr. H. Levinstein: Chemical Disarmament.

TWICKENHAM LITERARY AND SCIENTIFIC SOCIETY (at Free Library, Twickenham), at 8.—Capt. R. S. Gwatkin-Williams: In the Hands of the Senussi.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at the Abbey Hall, Plymouth).—Capt. P. P. Eckersley: Broadcasting by Electric Waves (Faraday Lecture).

INSTITUTION OF THE RUBBER INDUSTRY (London and District Section) (at Engineers' Club, Coventry Street, W.1).—B. B. Evans: The Sun-cracking of Vulcanised Rubber.

TUESDAY, FEBRUARY 4.

ELECTRICAL ASSOCIATION FOR WOMEN (at 15 Savoy Street, W.C.2), at 3.—G. S. Francis: Plastic Lighting and Modern Architecture.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. F. W. Aston: Isotopes (3).

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5.30.—Clinical Meeting.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—The Secretary: Report on the Additions to the Society's Menagerie during the months of November and December 1929.—E. Hollis: Exhibition of Skin of a Hen Pheasant showing Male Plumage.—J. Omer-Cooper: A Preliminary Investigation of the Fresh-water Fauna of Abyssinia.—Prof. S. J. Hickson: Report on the Hydras collected by Mr. J. Omer-Cooper in Abyssinia.—A. G. Lowndes: Freshwater Copepoda from Abyssinia collected by Mr. J. Omer-Cooper.—H. W. Parker: Report on the Amphibia collected by Mr. J. Omer-Cooper in Abyssinia.—Prof. S. J. Hickson: (*a*) On the Classification of the Alcyonaria; (*b*) Some Alcyonarians from the Western Pacific Ocean.—C. Ping: On the Cerebrum of *Felis tigris*.—A. Loveridge: A List of the Amphibia of the British Territories in East Africa (Uganda, Kenya Colony, Tanganyika Territory, and Zanzibar), together with Keys for the Diagnosis of the Species.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Hull Chemical and Engineering Society) (at Great Northern Station Hotel, Leeds), at 7.—Discussion on Fuel: Boiler Firing with Pulverised Fuel, H. Wheldon; Gaseous Fuel, B. Stonham; Boiler-House Theory and the Medium Sized Works, G. H. Whyatt.

INSTITUTE OF METALS (Birmingham Section) (at Chamber of Commerce, Birmingham), at 7.—J. McNeil: Nickel Casting Alloys.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—W. A. Clark: A London Pilgrimage.

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (Informal Meeting) (at Lamb's Restaurant, Dundee), at 7.30.—Discussion on Curious Faults and Experiences.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.—Prof. B. P. Haigh: The Relative Safety of Mild and High-tensile Steel under Alternating and Pulsating Stresses.

TELEVISION SOCIETY (at Engineers' Club, Coventry Street, W.1), at 8.—G. P. Barnard: The Photoconductivity of Selenium and various other Substances.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (jointly with Institution of Post Office Electrical Engineers).—S. S. A. Watkins: Talking Films.

WEDNESDAY, FEBRUARY 5.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—F. Prescott: Spallanzani on Spontaneous Generation and Digestion.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. J. H. Fisher: Some Points in Connexion with Perforating Injuries of the Eyeball.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. E. J. Garwood: The Tuedian Beds of Northern Cumberland and Roxburghshire east of the Liddelwater.—Sir Douglas Mawson: Pre-Ordovician Rocks of the McDonnell Ranges (Central Australia).

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section) (at City and Guilds Engineering College), at 6.—Short Papers on New Developments.

GLASGOW UNIVERSITY ALCHEMISTS' CLUB (at Glasgow University), at 7.30.—Prof. A. Hunter: The Nature and Action of Hormones.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—R. L. Andrew: The Determination of Minute Amounts of Iodine in Soils and Waters.—Dr. D. W. Kent-Jones and A. J. Amos: Preliminary Studies in the Bacteriology of Wheat and Flour.—Dr. H. J. S. Sand: The Separation of Metals by 'Internal Electrolysis'.—Ella M. Collin: The Rapid Determination of Bismuth and Copper in Lead Bullion by Internal Electrolysis.—G. W. Leeper: Notes on the Thiocyanate Method of Determining Iron. Influence of Different Classes of Phosphates.

ROYAL SOCIETY OF ARTS, at 8.—Sir William Clare Lees: Some Aspects of the Question of Trade with South America.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—T. Edwards, W. H. C. Romanis, Dr. L. S. T. Burrell, and Dr. F. G. Chandler: Discussion on Intra-thoracic Tumours.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough).

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, FEBRUARY 6.

ROYAL SOCIETY, at 4.30.—*Probably to be read:*—Prof. S. Chapman: A Note on the Measurement of the Specific Heats of Gases.—L. M. T. Gray and D. W. G. Style: The Absorption of Light by Chlorine, Bromine and their Gaseous Mixtures.—A. H. Davis and E. J. Evans: Measurement of Absorbing Power of Materials by the Stationary Wave Method.

LINNEAN SOCIETY, at 5.—Prof. R. R. Gates: Vegetation of the Mackenzie River Valley.—Dr. G. P. Bidder: The Importance of Cataclasms in Evolution.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—J. Hodgkinson: Conformal Representation by Means of Lamé Functions.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. R. L. Smith-Rose: Radio Direction Finding by Transmission and Reception.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—J. W. Maccoll: Modern Research in Germany.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (Annual Meeting) (at University College, Nottingham), at 7.10.—At 7.30.—C. F. Hammond: The Application of Submerged Combustion to the Dyeing, Laundry, Chemical and Allied Industries.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at Bristol University), at 7.30.—J. D. Pratt: Rationalisation.

CHEMICAL SOCIETY, at 8.—Prof. A. J. Allmand and D. W. G. Style: The Photolysis of Aqueous Hydrogen Peroxide Solutions. Part I. Experimental Methods; Part II. Experimental Results.—Miss R. V. Henley and E. E. Turner: The Scission of Diaryl Ethers and Related Compounds by Means of Piperidine. Part III. The Nitration of 2:4-dibromo-2^1:4^1-dinitrodiphenyl Ether and of 2:4-dibromophenyl p-toluene-sulphonate and Benzoate. The Chlorination and Bromination of m-nitrophenol.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—D. B. Nivison: Aircraft Production Methods.

FRIDAY, FEBRUARY 7.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—G. H. Tipper: Recent Mineral Developments in India.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir John Rose Bradford: Massive Collapse of the Lung.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—S. S. Cook: High-Pressure Steam for Marine Work.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6.30.—A. G. Lobley: Electric Furnaces for Heat Treatment.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Institute of Fuel) (at Engineers' Club, Manchester), at 7.—Prof. M. W. Travers: The Fundamental Problems of Flue Gas Purification.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—G. F. Shotter: A New Null Method of Testing Instrument Transformers and its Applications.—R. J. S. Spilsbury and Dr. A. H. M. Arnold: Some Accessory Apparatus for Precise Measurements of Alternating Current.—Dr. A. H. M. Arnold: Precision Testing of Current Transformers.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Practical Evening.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—W. G. Thompson: The Electrical Propulsion of Ships.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—G. F. O'Riordan: Co-operation between Technical Institutions and Industry.

GEOLOGISTS' ASSOCIATION (Annual General Meeting) (at University College), at 7.30.—Presidential Address: The Geological Life-Work of Sydney Savory Buckman.

PHILOLOGICAL SOCIETY (at University College), at 8.—Prof. V. G. Childe: Philology and Archæology.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—C. L. Hewer and I. W. Magill: Discussion on Anæsthesia in Thoracic Surgery.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. L. Hill: Diving.

SATURDAY, FEBRUARY 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. G. Cooke: Tonality and Form.

MINING INSTITUTE OF SCOTLAND (at Edinburgh).

PHYSIOLOGICAL SOCIETY (at St. Bartholomew's Hospital Medical College).

PUBLIC LECTURES.

SATURDAY, FEBRUARY 1.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. Martin Roberts: London in the Tudor Age.

TUESDAY, FEBRUARY 4.

GRESHAM COLLEGE, at 6.—Sir George Newman: Physic. (Succeeding Lectures on Feb. 5, 6, and 7.)

WEDNESDAY, FEBRUARY 5.

LONDON SCHOOL OF ECONOMICS, at 5.—R. J. Thompson: Economic Research in Agriculture—Its Bearing on the Supply of Food and Raw Materials.

UNIVERSITY COLLEGE, at 5.—Dr. R. J. Ludford: Cytology in Relation to Physiology and Pathology. (Succeeding Lectures on Feb. 12, 19, 26, Mar. 5 and 12.)

KING'S COLLEGE, at 5.30.—Prof. H. J. Rose: Methods of Research in Classical Mythology. (Succeeding Lectures on Feb. 6 and 7.)

AT 40 TORRINGTON SQUARE, at 5.30.—N. B. Jopson: The Early Civilisation and History of the Slavs. (Succeeding Lecture on Feb. 12).

BELFAST MUSEUM, at 8.—C. E. Kerr: Ulster Place Names.

THURSDAY, FEBRUARY 6.

KING'S COLLEGE, at 3.—C. J. Gadd: The Jews under the Persian Empire.

FRIDAY, FEBRUARY 7.

UNIVERSITY OF LEEDS, at 8.—Prof. Blanchard: Human Geography and the Methods of teaching Geography.

SATURDAY, FEBRUARY 8.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Ancient Egyptian Jewellery.

CONFERENCE.

WEDNESDAY, FEBRUARY 5.

GRASSLAND CONFERENCE (at Harper Adams Agricultural College, Newport, Salop), at 2.—Dr. J. A. Hanley, W. B. Mercer, and R. Boutflour: Addresses on the Formation, Maintenance, and Utilisation of Temporary and Permanent Pastures.