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CONTENTS.

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Minerals and Metals of the British Empire.

THE War brought into painful prominence certain facts regarding the resources and distribution of commodities, animal, vegetable, and mineral, which had indeed long been known, but the real significance of which in such a period of stress had not been fully grasped by any one of the Powers concerned. The waste of time, man-power, and material involved in the efforts made to overcome the resulting difficulties created a profound impression, from which flowed a stream of resolutions and good intentions. Meanwhile the years are slipping by and there is yet little indication of an Empire policy regarding minerals and metals.

While it is obvious that the development and conservation of the resources of the British Empire in plant and animal life require all the care and attention that can be given them, the case of minerals is peculiar. It is generally admitted that there is, in accessible form, enough of every mineral in the world to enable its inhabitants to carry on along present lines for a great period of time; but the distribution is unequal, the demand for certain minerals may at any moment overstep the known resources, new sources have to be discovered, and when they have been found and exploited they cannot be rejuvenated or replaced.

One of the lessons of the War was the need for each nation to be fully aware, in detail, of its own resources in minerals and of the means available for rendering them fit for industrial purposes and munitions of war; to be aware also of its actual relations with the rest of the world with respect to resources, transport, marketing, and treatment of minerals. The official statistics available to Governments are practically limited to those of production and of movements, represented by imports and exports. Such statistics, though better than none and essential for certain purposes, convey a totally erroneous conception of the actual resources of a territory; they throw no light on those available for future exploitation; they are always too late to indicate the significance of new finds; and they contain no reminder of the reserves that are fairly accurately known but are not exploited under the fiscal or commercial conditions that are prevalent at the time of their publication. For many years the United States, through its Geological Survey, and later, the Bureau of Mines, has done good service, not solely to its own nationals, by the publication of elaborate statistics relating to the mineral resources of the

States, with such figures as could be assembled regarding other countries, and frequently enlivened by informative reviews of the industry in specific minerals. It was not unnatural, therefore, on ground so well prepared, that Spurr's "Political and Commercial Geology," in 1920, should have stimulated the two leading institutions of American miners and metallurgists to form a joint committee under the chairmanship of Prof. C. K. Leith, to consider and report upon foreign and domestic mining policy and industrial preparedness ("International Control of Minerals." New York, 1925).

This Committee enunciated certain propositions "in the interest of efficient and conservational use of the world's mineral resources and in minimising international difficulties arising from the discovery, development, transportation, and marketing of mineral resources." The propositions put forward cannot be discussed here; in the main, they are equally applicable to any great State. In other quarters there is evident the same desire that these problems should be attacked; quite recently, from Germany, comes a proposal for the formation of an "International Institute of Mines." As things are at present, however, it is more practicable to restrict the field of action to States or federations of States.

The matter has recently been taken up with vigour by Sir Thomas Holland: in a presidential address in 1925 (*Trans. Inst. Min. and Met.*, **34**, 1925, pp. xliv-lxiii), he directed attention to the possibility of shortages of certain base metals in the not very distant future; in 1926, at the Royal Society of Arts ("International Interests in Raw Materials," *Jour. Roy. Soc. Arts*, **75**, 1926, pp. 42-61), he enlarged upon the need for investigation and collection of data regarding the natural resources of the British Empire; this has been followed up by his paper, a "Proposed Review of the Mineral Resources of the Empire," read before the Institution of Mining and Metallurgy on April 21, part of which is printed elsewhere in this issue.

In this paper Sir Thomas proposes that: "In each of the Dominions and, if possible, in each of the larger Colonies, committees of specialists should be appointed and entrusted with the duty of reviewing for each large State or unit of area its mineral resources and smelting capabilities, having in mind the desirability of accumulating, in addition to the ordinary official statistics of production and movement, the essential data necessary for the formulation of an economic policy, as well as for obtaining the information required to institute measures designed to secure military safety."

These proposals are now under discussion in London, and, if approved, it is intended to submit them, with such modifications as may be deemed desirable, for further discussion by the second Empire Congress of Mining and Metallurgy to be held in Canada this autumn. Should the Congress adopt the scheme and proceed to put it into being, there will be for the first time within the British Empire an organisation for the collection of live data and for the prompt examination and elucidation of their implications by men with knowledge of the facts.

The essence of the plan is decentralisation: in each territorial unit, whatever it may be, the special committee would be responsible for the collection and consideration of data within its ambit, and its methods would be those best suited to the local circumstances and special problems. The co-ordinating bodies would be the constituent members of the Empire Council of Mining and Metallurgical Institutions, established at the first Congress, held at Wembley in 1924, in order that each may benefit by the experience of the others, and especially in order that correlation and subsequent economic co-operation by the various Governments may be facilitated at future Imperial conferences of the kind recently held in London.

It is suggested that reports of progress made by the special committees in the Dominions during the next three years should be discussed at the Empire Mining and Metallurgical Congress, which will be arranged to follow that to be held at Montreal this year. The International Geological Congress has shown that it is possible, even with a very loose organisation, to assemble information of a most valuable character on specific subjects, exemplified in the reports on the world resources of coal and iron. The scheme to be laid before the Empire Congress in Canada is more far-reaching: it involves the consideration not only of the mineral resources and their development and treatment in the units of the British Empire, but also of the changing interactions, as adjustments take place due to new discoveries, new methods, new migrations of material, the growth of new industrial centres, and the consequences of political action. In short, to fulfil its functions properly, the proposed organisation must be not only alive but also assured of a prolonged life.

The territorial committees will have to concern themselves with such questions as the conservation of minerals; the encouragement of prospecting; the support of the geological survey, keeping it in touch with realities and advising on the choice of areas ripe for intensive geological investigation; the elimination of wasteful methods of mining, and of movement of ore; and the consideration of suitable centres for refining and smelting. The local mining laws should be critically examined with the view of simplification and, so far as possible, unification. Statistics should be analysed and presented in more useful form.

The discussion of these and other matters would be carried on by the Congress and Empire Council from the point of view of Empire requirements. Amongst the larger questions might appear that of State ownership of minerals, the inclusion of mining in the public utility services, the accumulation of reserve stocks, fiscal interrelations, etc., which cannot be dealt with by the official and State-aided organisations already existing for the collection and publication of mineral statistics.

While such an organisation as the Imperial Mineral Resources Bureau will doubtless continue to function usefully, the scheme outlined by Sir Thomas Holland would be far more effective in securing the essential details promptly and their consideration by specialists actually in touch with the ramifications of the industry. It is only by some such process that the great industries of mining and metallurgy can be brought into a position from which they can speak with full authority to their several Governments, and thus influence the creation of sound domestic and Empire politics.

An Engineer-Astronomer.

The Scientific Papers of William Parsons, Third Earl of Rosse, 1800–1867. Collected and republished by the Hon. Sir Charles Parsons, K.C.B., F.R.S. Pp. v + 221 + 18 plates. (Newcastle-upon-Tyne: Sir Howard Grubb, Parsons and Co., 1926.)

IT is always interesting and sometimes profitable to turn for a moment from the achievements of to-day to contemplate the difficulties, struggles, and aspirations of the pioneer in some special field of scientific endeavour. To do so, however, is not always a simple matter, since it often entails a laborious search through the publications of various learned societies; and, at the end of the search, a feeling that something of importance may after all have been missed. When, however, the whole of the written work of some specialist has been collected together and republished in one volume, it can be studied at any time with the greatest facility.

All those who are interested in the history and development of the reflecting telescope have cause for satisfaction in that this collation of scientific work has been effected in recent years in the case of two of the most distinguished pioneers in the construction and improvement of that instrument.

In 1912 the collected scientific papers of Sir William Herschel were published by the Royal and Royal Astronomical Societies. Among these papers is one which gives a fairly full account of the construction and working of that great 40-foot reflector which may justly be described as the world's first giant telescope, destined not to be doubled in aperture for 130 years. It is only to be regretted that Herschel published very few details of the purely optical part of his work. Fortunately, however, he did commit to writing a very full account of his methods of figuring specula; and, as this manuscript is still extant, it is to be hoped that it may yet one day be published.

We have now before us the scientific papers of William Parsons, third Earl of Rosse, brought together and published in one volume by his son, the Hon. Sir Charles Parsons. These papers, considered in relation to the work of Herschel, may be said to constitute the next chapter in the history of the reflecting telescope. Unlike Herschel, Lord Rosse had no special reason for reticence with regard to his methods, and the full account which he gives of his many optical experiments, successful and unsuccessful alike, makes very interesting reading. Thus, the first paper of the series, written in the days before he had fully mastered the art of figuring his specula to a paraboloid, describes a simple and ingenious method of reducing the aberrations of a spherical surface. This he accomplished by casting a speculum in two concentric parts, with a small space between them. The two parts were then worked together to what was, optically, a single spherical surface. The resulting spherical aberration was then reduced by drawing back the central portion by means of three fine screws. It is rather surprising to read that this apparently crude method proved successful in a mirror having a focal ratio of only 1 to 4; but, as the aperture of this speculum was only 6 in., it seems unlikely that it was called upon to bear very high powers. Yet its maker was so satisfied with it that he declared his intention of constructing one (in three pieces) so large as 18 in. in diameter. But no such instrument is afterwards mentioned, and it appears that Lord Rosse soon turned instead to more promising methods of improving, and more particularly enlarging, his specula.

In this connexion many of Lord Rosse's experiments were directed towards increasing the rigidity of metallic mirrors, and at the same time reducing their weight. To this end he tried the expedient of casting some specula of moderate size with backs braced by straight ribs, and some others with backs of a cellular structure. The results were not altogether successful, and it is interesting to note that similar experiments made on glass mirrors in recent years have also failed to justify expectations.

Most noteworthy, however, of all Lord Rosse's experiments are of course those connected with the casting and figuring of really large specula. The primary difficulty was the successful annealing of large masses of speculum metal in which the copper content was relatively low; for only to such mirrors was it possible to impart a really brilliant and lasting polish. While this difficulty was still outstanding, Lord Rosse turned for a time to an alternative expedient—that of building up a speculum of a number of thin plates of a highly reflective but brittle composition. These plates were soldered side by side to a stout backing of brass, so compounded as to have as nearly as possible the same coefficient of expansion. Except for diffraction effects, caused by the intervals between the plates, this built-up speculum, of 3 ft. diameter, seems to have been entirely successful.

Meanwhile a solution to the annealing problem had been found. It consisted in the casting of specula on a bed of hoop-iron packed tightly on edge. This promoted the rapid and regular cooling of the metal from below upwards, and by its means Lord Rosse was able successfully to cast specula of 6 ft. diameter. Two of these were eventually cast for use in the great reflector which marked the crowning point of the efforts of this tireless experimenter. The actual figuring of these great masses of metal, weighing three or four tons apiece, seems, strangely enough, to have presented comparatively little difficulty. It was of course necessary to devise special grinding and polishing machinery, all of which is fully described and illustrated in the papers; but previous experience with smaller specula had apparently done much to smooth the way for this greater undertaking. Much more serious was the difficulty of so mounting the finished mirror as to free it from the risk of flexure. However, this difficulty was almost completely met by mounting the speculum on a series of triangles, supported by levers, after the plan devised by Thomas Grubb. The design and erection of a mounting for the great telescope gave plenty of scope to the engineering ability of its constructor; and it is here worth remarking that the entire instrument was from first to last the product of local labour, under the instruction of Lord Rosse himself, and that the total cost was only £8000.

The actual work done with the great telescope, especially in revealing for the first time the spiral structure of certain nebulæ, is a matter of astronomical history, and need not here be described. One point, however, brought out clearly in the detailed description of the telescope's performance, seems worthy of emphasis in view of statements sometimes to be found in less authoritative accounts. We refer to the defining power of the great speculum, which has often been described as being of a distinctly inferior order. That there were many occasions when, in the climate of Ireland, such a telescope would perform but poorly, will be readily understood by all who have worked with large apertures; also it appears that flexure was occasionally a source of trouble; but, on the other hand, it is equally clear, from details given here and there in the papers, that the telescope did at times perform splendidly, even under high powers, which it certainly could not have done had the figure of the speculum been appreciably defective.

The volume closes with some interesting extracts from the correspondence of Lord Rosse bearing on the early history of the 'ironclad.' Apart from any value they may have had at the time they were written, they serve to illustrate the versatility of this remarkable man; and it seems worth remarking that they were destined to be by no means the last contributions of the Parsons family to the science of marine engineering.

W. H. S.

Specialised Plant Tissues.

(1) *Handbuch der Pflanzenanatomie.* Herausgegeben von Prof. K. Linsbauer. Abteilung 1, Teil 2: *Histologie.* Band 4: *Meristeme.* Von Dr. Otto Schüepp. Pp. vi+115. 8·70 gold marks. (2) Band 5: *Die Bewegungsgewerbe.* Von Prof. Dr. Hermann von Guttenberg. 25·50 gold marks. (Berlin: Gebrüder Borntraeger, 1926.)

(3) *Das Archiplasma: Betrachtungen über die Organisation das Pflanzenkörpers.* Von Prof. Dr. Hugo Miehe. Pp. vi+92. (Jena: Gustav Fischer, 1926.) 4 gold marks.

(1) DR. SCHÜEPP'S own contributions to our understanding of the part played by the plant meristem are a guarantee that this section of the new handbook of plant anatomy is in safe hands. He points out that after a period, from 1870 until

1880, when the meristem, and especially the growing point, was the centre of botanical interest, the subject has somewhat fallen into the background, to be brought forward again to-day, to some extent, in the attempt to understand some of the phenomena of graft hybridisation and especially periclinal chimæras. It is interesting, therefore, to see how concepts that were formulated in an earlier period of botanical activity fare when made the basis of treatment in a modern monograph of the subject.

Dr. Schüepp presents the subject as a problem requiring elucidation from the viewpoint of causal anatomy, but he is not inclined to attach great significance to attempts to explain cell division, its order and direction, along the lines of simple physical laws, as foreshadowed to some extent by Berthold in his "Stüdien über Protoplasmamechanik." He discusses the different types of apical meristem of the vascular cryptogam and the flowering plant, finding a transition between the apical cell of the former and the uniform meristematic tissue of the latter in the initial cells of the apex of the axis of the Lycopodiales and Gymnosperms. The initial cell is not an apical cell, because it is not characterised by special size, form, or manner of division, but it is a cell or group of cells from which all the tissues of the growing region derive. In the Gymnosperms, Haustein's distinctions of dermatogen, periblem, and plerome cannot hold, even the dermatogen showing occasional periclinal divisions, and the result of the discussion is evidently to minimise their importance in the complex construction of the Angiosperm apex. For the root another distinction of 'cap' and 'core' is drawn, the cell series in these two regions arising from the 'urmeristem' by a different order of cell division, which affects their symmetry as derivatives of the active apical meristem. Root systems are then classified according to the relative share these two tissues play in the differentiated root; the cap may only form the root cap—on the other hand, it may form every tissue from the outside of the root cap down to the endodermis.

Embryonic meristems are also briefly discussed, Sonèges being chiefly followed here, but the monograph is mainly valuable for its clear and critical discussion of the activity of the apical meristems of shoot and root. It is interesting to see that the theory that the endodermis acts as a tissue-absorbing pocket, in advance of the growing point of the secondary root, is given on the authority of the earlier workers without comment, though it has been thoroughly negatived by Friedrich Lenz (in 1910–11) and is not supported by any modern experimental work so far as is known to the reviewer.

(2) Prof. Guttenberg has made a very full compilation of the literature in a somewhat artificially delimited field of plant anatomy. Naturally the treatment is of adult tissues, without consideration of development, and from a strictly teleological viewpoint. The classification adopted in the same field by Haberlandt is followed without alteration.

Tissues involved in active movements such as dehiscence or growth mechanisms, etc., are first distinguished from tissues concerned in passive movements, such as the floating mechanisms of water-dispersed seeds and fruits. Tissues concerned in active movements are classified as dead or living tissue systems. In the dead systems those depending upon hygroscopic movements in anisotropic wall systems are distinguished from mechanisms such as the fern annulus, which depend upon the cohesive pull upon elastic walls, exerted by the gradual diminution of the water content in cells full of water. There is a very brief discussion of growth curvatures, as these are not usually associated with special tissue systems. A brief description of stomatal movement is found amongst living tissue systems associated with movement; this discussion is restricted to the effect of the histology of the guard cells and other special cells upon the movement mechanism. A very complete bibliography is included.

(3) In this monograph Prof. Miehe passes in review many of the puzzling facts associated with the capacity for reproduction, especially vegetative propagation, of the plant. He then suggests that the capacity of a cell to construct new protoplasm and then multiply by division, in other words, the meristematic properties of the cell, may be a function of its content in a special type of protoplasm, the 'archiplasm.' Cells of the permanent tissue, incapable of reproduction, are then deficient in this 'archiplasm.' Prof. Miehe terms them 'ergoblasts' as compared with the potentially reproductive 'archiplasts,' which in the meristem of a growing point may be massed in an 'archenchyma.' This new viewpoint evidently admits of a re-interpretation of well-known phenomena in terms of a new phraseology, but as the 'archiplasma' cannot be recognised save by its effects on reproduction, and as no new experimental method of attack is suggested, it is questionable if it does much more. It at least puts upon record

Prof. Miehe's view that all living cells of the plant cannot be regarded as ' totipotent ' in reproduction, a viewpoint towards which Vochting's experiments had led him.

This theoretical conception of the ' archiplasm ' is applied in a very brief general review of reproduction and regeneration in the plant. The subject is one on which generalised statements are difficult to make, and two are noted to which exception can certainly be taken, namely, the statements (p. 37) that adventitious roots arising upon shoots always appear in the pericycle, and (p. 39) that the phellogen is a tissue which is never associated with the origin of buds.

Synoptic Psychology.

Mind and Personality: an Essay in Psychology and Philosophy. By Dr. William Brown. Pp. x + 344. (London: University of London Press, Ltd., 1926.) 12*s.* 6*d.* net.

ALL those who are well acquainted with recent psychological thought must turn with unusual interest to a comprehensive expression of the views of Dr. William Brown. This they will find set forth in the volume now offered to us, which—to use the author's own words—is " an attempt to obtain a synoptic view of personality, as considered from the standpoints of the various sciences—especially from those of psychology, psycho-pathology, and philosophy."

Besides these three sciences, however, there might well have also been made a claim for physiology. For from this latter it is that Dr. Brown first embarks upon his course, and in a definitely anti-mechanistic direction. " Although the body," he says, " does obey physical and chemical laws, processes nevertheless go on in it which are inexplicable in those terms." Among the non-mechanical characteristics of bodily conduct he enumerates " spontaneity," " persistence of action after the stimulus producing the action has disappeared," " the coming to an end of the activity after a certain purpose has been achieved," " the power of learning by experience," the action of " the organism as a whole " ; in short, the fundamental fact that " all animal behaviour is purposive."

Turning to the point of view of psychology, we find that the author rather curiously trisects this into " psychology " pure and simple, " experimental psychology," and " child psychology." Dominating the first of these three divisions comes for him the conception of the mind " as a system of interests, with emotional reactions, showing different degrees of unity in the systems of subordinate unities ; these systems being incorporated in wider systems, and these wider systems again being incorporated in still wider systems, till at last one has a total system dominated by one all-satisfying interest." As for " volition," this he takes to consist of " the whole character in action with the sentiment of self-respect in command." In his second or " experimental " division of psychology we come upon an assortment of such topics as psycho-physical methods, cutaneous sensibility, visual experience, mental variation, and mathematical ability. His third and last division, that which deals with the child, is most notable for warning that undesirable juvenile propensities should be counteracted, not by " repression," but instead either by " substitution " or else by " sublimation."

From the author's next scientific point of view, that of psycho-pathology, he strongly defends the distinction that has been drawn between " organic " and " functional " nervous disorders. As regards the latter, he urges that " physical and physiological methods of treatment have shown themselves thoroughly inadequate to cope with the situation." In their place he recommends, not so much " psycho-analysis " in particular, as rather " deep analysis " in general. This supplies a procedure whereby to resolve the abnormal systems of interests called " complexes," as also possibly the normal systems called " sentiments." Here — and indeed almost throughout — he is greatly influenced by the teachings of Freud, which he either admiringly accepts or else sharply contests. An example of the critical attitude is his emphatic rejection of the belief that a young child has ever present a strong feeling of hostility towards the parent of like sex. He further repudiates the suggestion that the unity of the mind has been proved to be a comparatively late mental product. On the contrary, he says, " the results of psychological analysis itself show an underlying thoroughgoing unity."

The author's third or philosophic point of view brings him to the topic of ethics ; and here he ranges himself on the side of the intuitionist school. Turning, next, to the theory of evolution, he proceeds to combat the " aimless freedom of spontaneous activity and pure duration " advocated by Bergson, and would substitute in its place the " real freedom of deliberate choice." Then follows his treatment of the problem which appears to have for him the deepest interest of all ; it is that of religion, which he defines as an attitude "of personal relationship towards the universe." This leads him, finally, to the region of mysticism, where his counsel is that we should seek to transcend time and in such wise follow the exhortation of Aristotle "to be immortal as far as possible even in this life."

On the whole, Dr. Brown ranges over an extraordinarily wide field. But for so doing he can at least claim the high sanction: *Wer vieles bringt, wird manchem etwas bringen.*

C. Spearman.

A New Approach to Zoology.

The Elements of General Zoology: a Guide to the Study of Animal Biology, correlating Function and Structure; with Notes on Practical Exercises. By Prof. William J. Dakin. Pp. xvi+496. (London: Oxford University Press, 1927.) 12*s.* 6*d.* net.

ZOOLOGY has been suffering during recent years under the unjust and wholly undeserved criticism that it does not readily lend itself to experiment and is therefore, in this respect, inferior to botany as a subject for inclusion in the school curriculum. It is true that there is still a tendency to lay too much stress on structures and to neglect the functions served by those structures, but this is the fault of the teachers rather than the subject. Prof. Dakin's book is at once a complete justification of the right of zoology to be considered as an experimental subject for school work, and a guide to the teacher as to how the relative claims of function and structure can be adequately met in their courses. Function is the dominating note of the book and, except for a chapter specially devoted to the Protozoa, the subject matter is arranged under the headings of the various functions of animals and not under the customary systematic groups. In dealing with any one function, the author has given just so much structural detail of the organs concerned as is necessary for a proper comprehension of their uses, and has saved much valuable space by the free use of carefully annotated drawings and diagrams to impart the details of anatomy.

Among the most valuable parts of the book are the experiments, which are carefully outlined in each chapter, for practical demonstration of the physiological processes underlying function. The material chosen for these experiments is readily obtainable and easy to manipulate; the experiments themselves are simple and the apparatus inexpensive. With these as their guide, teachers should have little difficulty in making intelligible, even to their younger pupils, the life processes of the living animal. They will at least be able to make zoology a living science.

The book is intended mainly as a guide to the study of animals through their functions, but in order to meet the needs of laboratories where one type is studied at a time in the practical classes (and this must inevitably be the case in most school laboratories), the author has assembled in the index all references to a particular type under one heading, so that the book readily lends itself for use as a practical text-book from the systematic point of view. Special praise must be accorded to the illustrations. Not only are they clearly and beautifully reproduced, but also they have been chosen with great care, and in nearly all cases have been modified and specially annotated. Their value has been enhanced enormously thereby.

Prof. Dakin has, in our opinion, abundantly justified the preparation and publication of this book. It strikes a new note in text-books of zoology, and should prove of incalculable help to teachers of biology in schools, while university teachers will find much in it of real use for their intermediate courses. It is the most refreshing and stimulating text-book, from the teachers' point of view, that has been published for some time. The Oxford Press deserves special commendation, not only for the admirable way in which the book has been produced, but also for its remarkably low price.

Our Bookshelf.

Ancient Cities and Modern Tribes: Exploration and Adventure in Maya Lands. By Thomas Gann. Pp. 256+32 plates. (London: Gerald Duckworth and Co., Ltd., 1926.) 21*s.* net.

For several years past, Dr. Gann has published annually a volume containing an account of his adventures and experiences while engaged in archæological exploration in Central America during the preceding winter. Entertaining and instructive as the preceding narratives have been, the present surpasses them in interest, as it contains not only an account of the further exploration of the remarkable site of Lubaantun, opened up in the preceding year, but it also records one of the most sensational discoveries hitherto made in American chronology, as well as the revelation of an entirely new and unexpected centre of Mayan culture, of which many features are unique.

Any one of these achievements would have served to assure the success of the expedition from the scientific point of view, and would have afforded ample compensation for the hardships it entailed.

The dated stela found at Chetumal Bay shows an Initial Series which, on Spender's correlation, corresponds to Oct. 26, A.D. 333. This is the earliest of the four series found in Yucatan by nearly three centuries, and shows that the Maya had obtained a foothold in this part of the country long before it was supposed to be inhabited at all. Dr. Gann, after visiting the "Cave of Flowers," which he suggests with reason may yield to exploration vestiges of early man, went on to Coba, attracted thither by a suggestion in a recent translation of an ancient Maya manuscript. The gigantic causeway leading to the site must be, in its way, one of the most remarkable achievements of Maya mechanical skill, while the temple mound at Coba itself is probably the highest in Yucatan. The special interest of the site, apart from the many peculiar characters of its three types of Maya civilisation, lies in the fact that it does not appear to have come under Toltec domination—a fact which will undoubtedly prove of no little importance when the exact bearing of Dr. Gann's discoveries on Maya history has been worked out.

It has not been possible even to touch upon the many matters of the greatest archæological interest to which Dr. Gann himself has sometimes only been able to refer in passing, and a more extended and detailed report will be eagerly awaited. It must not be thought, however, that Dr. Gann has confined himself to matters archæological. His account of the incidents of his journey and of the people he met are, as usual, both informative and amusing.

Zoologisches Wörterbuch: Erklärung der zoologischen Fachausdrücke; zum Gebrauch beim Studium zoologischer, anatomischer, entwicklungsgeschichtlicher und naturphilosophischer Werke. Verfasst von Prof. Dr. E. Bresslau und Prof. Dr. H. E. Ziegler. Unter Mitwirkung von Prof. J. Eichler, Prof. Dr. E. Fraas, Prof. Dr. K. Lampert, Prof. Dr. Heinrich Schmidt, und Prof. Dr. J. Wilhelmi. Revidiert und herausgegeben von Prof. Dr. H. E. Ziegler und Prof. Dr. E. Bresslau. Dritte vermehrte und verbesserte Auflage. Pp. viii + 786. (Jena: Gustav Fischer, 1927.) 28 gold marks.

THE proof of the first half of this new edition was corrected when the sudden death of the senior author, Prof. H. E. Ziegler, occurred on June 1, 1925. Prof. Bresslau has therefore been responsible for the revision of the second half of the volume. The aim of the book is to give a definition or brief explanation of the terms used in zoology, of the classes and orders of animals, of the most important families, and of those genera which are of special significance from a theoretical or from an economic point of view. The classical origins of the terms and of the generic names are given, and in many cases the author of a term is cited, *e.g.* "Gastrula (Haeckel, 1872)."

The authors must have been often faced with the difficulty as to what to include and what to omit, and individual readers will no doubt wish that more could have been included. For example, Gyrodactylus and mitochondria receive notice, but Gyrocotyle, Stegomyia, and the Golgi apparatus are omitted. Errors appear to be remarkably few; Bilharzia is said to occur in the kidney, the fleas are stated to form a single family (modern practice is to divide them into two families), and Geotria is referred to as a South American genus, whereas three of its four known species are Australasian.

The cross references are in several cases out-of-date, *e.g.* under Ancylostomum (the official spelling is Ancylostoma) the reader is referred to Dochmius, and under Giardia to Cercomonas, but Ancylostoma and Giardia are the names now in use, and the description should be under these heads and not under the obsolete names. The illustrations (575 in number) are on the whole good, but a few are unsatisfactory, *e.g. Balantidium coli*, *Pulex irritans*, malaria and Sarcocystis (especially the spores). But these are small blemishes in a work so large and so difficult to prepare. The volume may be recommended as a helpful and trustworthy work of reference.

Electrical Contracting: a Guide and Handbook specially designed to meet the Needs of all those engaged in Business as Electrical Contractors. By H. Ayres Purdie. Pp. xxxii + 375. (London: Ernest Benn, Ltd., 1926.) 10*s.* 6*d.* net.

ELECTRICAL contractors form a very important section of the engineering industry. It is curious, therefore, that so few books are published to meet their needs. It is necessary that they should know the best method of organising their businesses, preparing estimates, reading and supplying specifications, and preparing schemes for lighting, heating, and power. They have also to know the best materials to use in given cases.

We think that this book under notice will be found of practical use to contractors. In an introduction, stress is laid on the importance of good workmanship. To have cheap materials properly installed by a conscientiously competent workman is much preferable to having good materials casually and carelessly installed. Screwed steel conduit, for example, even when of the best quality, does not signify a safe installation if improperly fitted up. Special care has to be taken when choosing switches for bathrooms, kitchens, cellars, and so on. It is specially important also that the 'earthing' of the conduit be efficiently done. Useful information is given on illumination work, the number of foot candles required for all kinds of lighting being specified. The methods of installing electrical signs are described. We are told that the well-known 'neon' illumination of the Coliseum, Charing Cross, London, and the enormous *Daily Mail* sign at Blackfriars Bridge over the Thames, consume only 22 and 15 units per hour respectively. The high-tension side of these signs, which operates at pressures not less than 2000 volts and is consequently dangerous, is erected by the makers themselves. It is pointed out that it is sometimes advantageous to work the electric bells in a house from the alternating current supply.

The Steam-Engine and other Heat-Engines. By Sir J. Alfred Ewing. Fourth edition, revised and enlarged. Pp. viii + 662. (Cambridge: At the University Press, 1926.) 25*s.* net.

This well-known work, which on its first appearance in 1894 set up a new standard of excellence in the writing of text-books on this subject, now appears as a fourth edition extensively revised and enlarged. In its pages students can gain a very good idea of the history of the development of heat-engines, while the basic thermodynamic theory is expressed with a notable clarity, simplicity, and scientific accuracy.

In new editions of standard text-books the additions are always of especial interest, and we now find here an enlarged section on the theory and practice relating to steam turbines, which in about a hundred pages gives an admirable survey of the subject. It is perhaps not possible now to give so connected an account of the internal combustion engine, which has become a serious rival to the steam turbine for the propulsion of ships. The battle is still being waged, but whatever may be the issue, applied science gains by the researches of Callendar and others on the properties of steam at great pressures and high superheats, and by the various investigations on the properties of the explosive charge in the cylinders of internal combustion engines, described in this volume. Many other subjects, arising from the great sizes of the engines now being designed and built, are dealt with; much research on these subjects has been carried out, and is still proceeding, in order to provide successfully for motive power in units of unprecedented size.

Students will be especially grateful for a text-book which covers so wide a range and brings them up to the boundary of existing knowledge.

E. G. C.

Floræ Siamensis Enumeratio: a List of the Plants known from Siam, with Records of their Occurrence. By Prof. W. G. Craib. (Published under the Auspices of the Siam Society.) Vol. 1, Parts 1 and 2: *Ranunculaceæ* to *Anacardiaceæ.* Pp. 1-197 and 198-358. (Bangkok: *Bangkok Times* Press, Ltd.; London: Luzac and Co., 1925 and 1926.) 7 Tcs.; 12*s.* 10*d.* each.

A useful compilation, of which the first two parts have appeared, is in course of publication. It is a catalogue of all plants collected in Siam, with a full record of collectors' specimens, references to literature and synonymy, together with occasional notes by the author, who has critically examined, wherever possible, the type specimens and other specimens quoted. The local Siamese and Malay names are given. No new species are recorded, though very many of those listed have been described by the author himself in the *Kew Bulletin* from material supplied by recent collectors, chiefly Dr. A. F. G. Kerr, Mrs. D. J. Collins, and members of the Siam Forest Service.

The geographical situation of Siam lends special importance to its flora, for it is a focus for intrusive plants from south-west China, Burma, and the Malay Peninsula. Possibly also (with the adjacent countries which go to make up Indo-China) it has been a centre from which certain species have been disseminated. It must, therefore, have a considerable bearing on the floristic relationship of those different regions.

C. Fischer.

Crime and Custom in Savage Society. By Dr. Bronislaw Malinowski. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xii + 132 + 6 plates. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1926.) 5*s.* net.

Part of this stimulating essay on primitive jurisprudence was delivered by Dr. Malinowski as a lecture at the Royal Institution and published in extended form in our columns (Nature, Feb. 6, 1926, Supplement, p. 9). It is scarcely necessary, therefore, to do more than direct attention to its publication in book form, and to say that in the added matter the author has amplified his main contention that much of the general theory of the older school of anthropology fails to stand the test to which it can be submitted by the field-worker. In the present instance, in the field of primitive jurisprudence, Dr. Malinowski, with his acutely critical power of analysis, is able to show from his experience among the Trobrianders that the idea of group dominance is inadequate as a sanction of law and order in primitive society.

The Garden Interests of Madeira. By Dr. M. C. Grabham. Pp. xii + 100 + 3 plates. (London: Printed by William Clowes and Sons, Ltd., 1926.) 5*s.*

Dr. Grabham has written an interesting and useful little book on the plants found in gardens and growing wild in Madeira, which should be of value to visitors to this favoured island. In the second part the plants are discussed under their respective families and useful notes are given about them. The first part contains a good deal of miscellaneous information about the plants and their times of flowering, the various fruits and vegetables to be met with at different seasons, and other matters of interest to the visitor. This part fittingly contains at the end a portrait of the venerable and versatile author bearing the legend, "Archangelicus maderensis!"

The Way of the Wild. By H. R. Sass. Pp. vii + 321. (London: T. Fisher Unwin, Ltd., 1926.) 7*s.* 6*d.* net.

A series of ten animal stories dealing with the adventures of a wide range of North American creatures, from owls and eagles to racoons, pumas, and bison. The stories are linked with the experiences of white hunters and Indians; they are well written, full of interest and excitement, and the author has avoided the danger of swamping the soundness of his natural history by a too vivid imagination. The value of the book lies in the likelihood that it may arouse in many who are not naturalists an appreciation of and sympathy with the lives of wild creatures, and naturalist and non-naturalist will enjoy the stories.

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.*]

X-ray Investigation of the Polymorphism of Fatty Acids.

DURING recent years X-ray analysis has been successfully applied to the investigation of long-chain organic compounds. The method seems especially adapted to the study of polymorphism of such substances (Piper, Malkin, and Austin, *Jour. Chem. Soc.*, 1926; 2310. G. M. de Boer, NATURE, Jan. 8, 1927. J. Thibaud, *C.R.*, 184, 24, 96; 1927).

The easiest method to follow is to make a thin film of the substance on a glass strip (by melting or by crystallising from a solution) and to use this as a 'turning crystal' in the X-ray spectrograph. By exposing the film to monochromatic X-rays, rather sharp lines are obtained, which are due to a *long spacing* present in the micro-crystalline film. This long spacing is a beautiful characteristic of the modifications of the substance which sometimes gives information not so well afforded by an investigation of other physical constants as the heat of transformation.

In continuation of such former work, I have studied in this manner the influence of temperature on the modifications of the odd and even saturated fatty acids. For this purpose the preparation was placed inside a small thermostat, which was mounted on the crystal table of the spectrograph. For the passage of the X-rays the thermostat was fitted with two windows covered with goldbeater skin. By electric heating it was possible to obtain temperatures from room temperature up to 60°, the temperature being measured with a mercury thermometer.

Using copper $K\alpha$ radiation, photographs were taken at different temperatures showing the lower orders of reflection of the long spacing. The distance between the third and fifth orders was measured, and from this the spacing was calculated.

The data obtained with the *odd* acids, which behave differently in general from the even acids, are summarised in the following table:

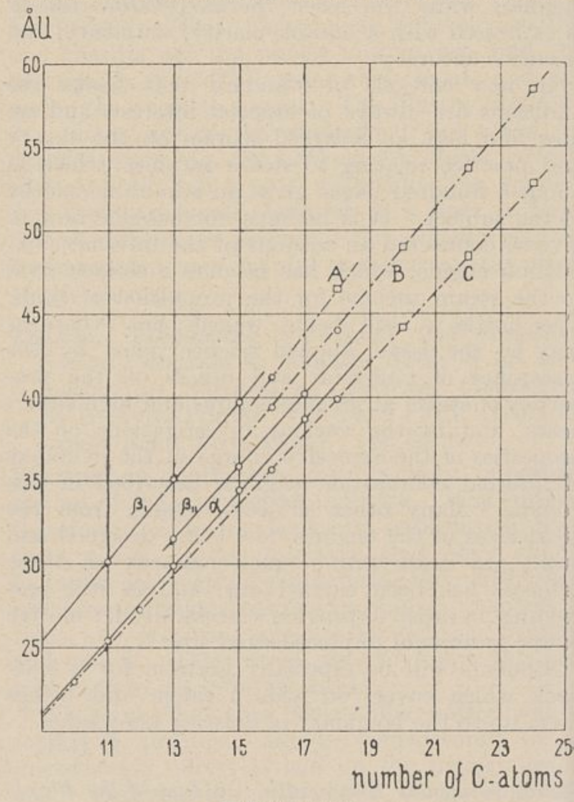
Acid.	Melting Point.	Transition Point.	Spacing of the Modification. At Lower Temp. β_{I}.	β_{II}.	At Higher Temp. α.
	° C.	° C.	Å.U.	Å.U.	Å.U.
$C_{11}H_{22}O_2$	28·2	17	30·1	..	25·4
$C_{13}H_{26}O_2$	41·2	32	35·1	31·5	29·8
$C_{15}H_{30}O_2$	52·1	44	39·7	35·9	34·4
$C_{17}H_{34}O_2$	60·6	54	..	40·2	38·7

At the transition point, the β-modifications pass into the α-modification and vice versa.

The presence of *two* β-modifications in the table needs some further explanation:

At the lower temperature, in the case of C_{11} and C_{13}, all specimens showed the 'β_{I}-spacing,' whereas films of C_{15} and C_{17} always showed the 'β_{II}-spacing.' It was possible, however, to obtain in some ways films of C_{13} showing not only the β_{I}- but also the β_{II}-spacing, and films of C_{15} showing, besides the β_{II}-spacing, also the β_{I}-spacing. When these films, however, after first being transformed into the α-modification, were again cooled down below the transition temperature, the α-lines of course disappeared, but only lines due to *one* β-modification reappeared. In the case of C_{13} this was the β_{I}-modification, in the case of C_{15} the β_{II}-modification.

From this we may conclude that the β_{I}-modification is the stable one of C_{13} and the β_{II}- of C_{15}. It must be observed, however, that heating the preparation for several hours at about 2° below the transition point did not seem to have any influence on the relative intensities of the lines due to the two β-spacings. This proves that if it should be possible to transform immediately the less stable form into the more stable one, the rate of this transformation at least must be very slow.



□ Piper's values.
○ de Boer's values.

FIG. 1.—Spacing constants as a function of the number of C-atoms of the molecule. The dotted lines relate to the even acids, and the continuous lines to the odd acids.

Though several trials were made under different conditions, I never succeeded in observing a β_{II}-modification of C_{11} or a β_{I}-modification of C_{17}.

For some of the *even* fatty acids Piper has found three different modifications at room temperature which he calls A-, B-, and C-modifications. According to Piper, these modifications are independent of the temperature, their occurrence depending only on the way the preparation is obtained.

In the present investigation, however, I could show that these modifications are also influenced in a certain way by temperature. For example, starting with a preparation of palmitic acid, which showed at room temperature three modifications at the same time (spacings A 41·2; B 39·5; C 35·8 Å.U.) and heating at 45° for three hours, the B-lines had nearly disappeared, the A-lines persisted in about the same intensity, whereas the C-lines had much increased. Raising the temperature to 50° for two hours, the A- and B-lines both had wholly disappeared, whereas only C-lines appeared on the plate. Raising again the temperature to 59°, no further changes occurred. On cooling down again to room temperature, a photograph was obtained identical with that at 59°; no A or B spacing reappeared. In the case of stearic acid, starting with a film which showed only the B-lines at room temperature, after heating to 55° only the C-lines were observed. In the case of capric and lauric acid, only the C-modification was found at room temperature, which remained unchanged when heating at some degrees below the melting temperature.

Thus the even fatty acids seem to have only monotropic modifications of which the C-modification is the stable one.

In the accompanying diagram (Fig. 1) the spacings observed are plotted against the number of carbon atoms of the corresponding molecule. So far there seems to be no simple relation between the spacings of the even and the odd acids.

Our results seem to confirm some suggestions already given by Garner (Garner, Madden, and Rushbrooke, *Jour. Chem. Soc.*, 1926; 2491).

I have to thank Mr. J. A. Prins for much helpful advice during the course of the work.

In conclusion, I wish to express my thanks to Prof. P. E. Verkade, of Rotterdam, for supplying several pure fatty acids, and to Prof. W. E. Garner, of London, who put some pure heptadecylic acid at my disposal.

G. M. de Boer.

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The Nuptial Pad of Kammerer's Water-bred Alytes.

Some time ago a friend of mine who was interested in my amateurish experiments on frogs took some pictures which he intended for publication. He found it necessary to bring out some of the natural markings with ink so that they would reproduce better in print. I am wondering if the marking of Kammerer's specimens which led to his suicide might not have an equally simple explanation.

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Kammerer's untimely death has confronted us with three problems, seeming intrinsically interwoven, but, as it appears now, distinct enough to be dealt with separately: they are—

(1) The motives of his suicide; (2) the mystery of the 'doctored' specimen; (3) the validity of the original experiments on the nuptial pads in Alytes.

The first question is chiefly psychological, the second criminal, while only the third concerns biological science proper. Whilst we can conjecture the motives of Kammerer's weariness of life (see *Monistische Monatshefte*, 11, 401, Nov. 1926; R. Wettstein, *Neue Freie Presse*, Dec. 16, 1926), we are at a loss as to the person who may have injected specimens with Indian ink or with what intention this may have been done. It seems not impossible that Mr. W. C. Kiplinger's suggestion is correct and that the injection was intended to enhance a faded appearance in order to get a good photograph, although the existence of other doctored specimens does not seem to be in favour of this version. A picture was taken in September 1922, not in the Biologische Versuchsanstalt, but in the photographic studio Reiffenstein, of the well-known specimen, and only from thence onwards do the mis-statements begin. On the other hand, up to 1919 the descriptions and figures of nuptial pads in Alytes given by Kammerer do not fit in with this specimen. We are therefore able to exempt any one who died before 1919, or had no contact with the Institute after that year, from any suspicion at having made the injection; for example, Dr. F. Megušar, who was killed at the Wolhynian front on Aug. 3, 1916 (see *Archiv für Entwickl.-mech.*, 42, 222; 1917).

We have been able to collect five proofs that in his original papers Kammerer was not hampered by the doctored specimen which has invalidated his remarks on the same subject in his books "Inheritance of Acquired Characteristics" (1924) and "Neuvererbung" (1925). By comparing dates and photographs we can now formulate these proofs even before the new experimental evidence which Kammerer's collaborators in Moscow are trying to get is available: the proofs are as follows:

(1) In Kammerer's original papers the nuptial pad in Alytes is described and pictured as being "on the dorsal side of the thumb and on the thumb-ball" (1909, p. 516, fig. 26*a*), "on the dorsal and radial side of the first fingers" (1919, p. 336), and "across the thumb-ball on the whole internal side of the fore-arm to near the elbow" (p. 337, tb. x, fig. 2), in accord with the general appearance of nuptial pads. Even in 1923, when Kammerer showed a lantern slide of the critical specimen before the Zoological Society of London, he did not mention the disposition of the nuptial pad on the whole palm of the hand (see Bateson, Nature, Dec. 22, 1923, and letter to Przibram). It was not until the photographs of this specimen were used in his books (1924, p. 53, fig. 9 to the right; 1925, fig. 9, facing p. 20) that Kammerer mentions and defends the untoward position of the pad in the palm and on the outer border of the last (fourth) finger.

(2) The photograph in his original paper (1919, tb. x. fig. 2), taken by E. B. Congdon (see *ib.* p. 369) in Kammerer's and my presence in 1913 (letter of Congdon, professor at the Chulalangkara Medical School, Bangkok, Jan. 8, 1927), shows a narcotised Alytes with nuptial pads on the radial side of hand and arm.

(3) The drawings by Kaspar of microtome sections (Kammerer, 1919, p. 370, tb. 11, figs. 7, 9), and the photos thereof by Prof. H. Joseph (*ib.* tb. 10, fig. 4), relate to skin taken in 1913 (see *ib.* p. 331) from the hands of Alytes in Kammerer's presence by Olga Kermauner, sister of Prof. Kermauner, of the University of Vienna, now married to Mr. Critikos. This lady histologist herself prepared all the slides and remembers having been struck by the difference in those of the water-bred Alytes as compared with the normals from the beginning (letter by Mrs. Olga Critikos, 914 Leland Ave., Chicago, Dec. 15, 1926).

(4) Comparing the known forms of nuptial pads in other species as to their horny spicules (Lataste, Meisenheimer, Harms, Kändler, etc.) with these drawings and photos of Alytes, there seems to be full specificity of these structures. Even the sections of *Bombina maxima*, the nearest approach to Alytes, can easily be distinguished from the photographs and drawings which Dr. Noble (Museum, New York) has sent me. The species *B. maxima* was not known to Kammerer and has never been kept alive at our Institute (see list of animals, *Zeitschrift biol. Technik u. Methodik*, 3, 163; 1913, p. 214).

(5) The histological features of Kammerer's sections of nuptial pads in Alytes are furthermore identical with those of a specimen found in Nature by R. Kändler (*Jenaische Zeitschrift*, 60, 175; 1924, tb. x. fig. 12) with rudimentary nuptial pads. The stratification and relative nuclear sizes of the said sections

are also exactly duplicated by those of sections taken from normal Alytes (Kammerer, 1919, tab. 11, figs. 1, 2, and photographs sent by Dr. Noble).

These five proofs being each conclusive and independent of each other, I should think the nuptial pads in water-bred Alytes must be seriously taken into consideration, unless some one should offer another explanation of the coincidence of the five points raised here. HANS PRZIBRAM.

Vienna II., Prater,
Vivarium, Mar. 26.

Science and Food Production.

IN the very sympathetic notice of my book, "Plant Nutrition and Crop Production," in NATURE of Mar. 26, p. 454, the reviewer raises the interesting question how far science has actually helped in increasing the production of food. Statistics show that, in spite of the scientific work, the yield of wheat per acre in England is not much greater than it was fifty years ago, and it is implied that scientific work has in practice achieved little, however interesting its results may have been from other points of view.

The statement is partly true, but the conclusion is entirely wrong. There are several ways in which food production may be assisted by science, among them: (1) increasing the output per acre of land, (2) increasing the output per man-hour of labour, (3) increasing the area of cultivated land. The great development of transport during the past fifty years led to the opening up of new countries, and made the third of these possibilities the easiest; it was consequently adopted. The extension in area of cultivated land has proceeded *pari passu* with the growth of the population, and there are still, as there were fifty years ago, some two acres of cultivated land for each civilised human being. There has been no pressing necessity, and therefore no economic inducement, to increase output per acre.

The great increase in rates of farm wages, however, has compelled an increased output per man-hour of labour, and this has been accomplished. In 1881 on a farm of careful management and careful records it took 117 man-hours to grow one ton of wheat; in 1921 only 82 hours were needed. Equally marked changes have taken place in the root crops.

Further, science has greatly increased the certainty of crop yields: catastrophes are things of the past. In 1844 potato blight came to the British Isles, and for forty years its depredations were almost unchecked. It caused the appalling Irish famine of 1845–46, and between 1877 and 1880 its damage in Ireland alone was estimated at £20,000,000. The committee of inquiry set up in 1880 reported that all witnesses, scientific and practical, believed it to be hopeless to prevent the spread of the disease once it had set in.

All this is changed; an effective fungicide now keeps the disease in bounds so that it is no longer feared.

By common consent the worst season of the last century for the wheat crop was 1879, when the persistent wetness and high rainfall completely baffled the farmers of Great Britain. The financial losses were appalling, and the season was long remembered with dread in the countryside. During the present century there have already been three years of higher rainfall, 1903, 1912, and 1924, than 1879, but there was no agricultural crisis. Of course there were losses, but they did not compare with those of 1879, and they are already almost forgotten.

The statement, frequently made, that yields have not increased, is only partially true. Wheat is commonly taken as the test crop, but this is unfair. It was formerly the most important crop on the farm, but now it is much less important. The high yields of fifty years ago were attained by abundance of cheap labour; to-day this method is not available. New methods have been devised which pay the labourer several times the old wages and which yield at least as much produce per acre. More direct comparison can be made by taking crops in which we have been self-supporting over the whole period and for which therefore the relative importance in the farm economy has not diminished. Precise statistics of average yields are difficult to obtain, but trustworthy experts fifty years ago put the yield of potatoes at about 6½ tons per acre under good farming conditions. Now, however, a good farmer would expect 10 tons per acre, and could reasonably hope for more. Similar increases can be recorded for some of the fruit and market garden crops, as well as the important cucumber and tomato crops.

It is freely admitted, of course, that science has not been the only factor at work. The makers of implements, and fertilisers and feeding-stuffs, seedsmen, the country school teacher, and the farmers themselves have all played their part, but it is impossible to deny that science has largely contributed to the result.

Finally, scientific work has demonstrated that this intensification of production is possible for all farm produce. At the present time much of the knowledge remains unused in regard to certain items such as wheat, lower qualities of meat, etc., because the alternative method of increasing the area of cultivated land still remains open and is cheaper. But obviously this will not always be the position, and it is perhaps the crowning achievement of agricultural science that it is steadily working at methods of intensification, knowledge of which will be imperative directly the area of cultivated land has reached its limit.

E. J. RUSSELL.

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IT WAS far from my intention to suggest that science, generally, had failed to help in increasing the production of food, and least of all to base such an assertion on official statistics of the average yield of wheat. If Sir John Russell had heard Venn's smashing indictment of official underestimating, delivered last year at Oxford, he would not tilt at that windmill. All I need plead guilty to is extreme sympathy with the view that the value of science is not merely materialistic; but until this sympathy is more universal than it is now, the unenlightened public will not cease to clamour for more spectacular results than agricultural science, in its 'slow and painful' progress, has produced in the last fifty years.

THE REVIEWER.

The Sleep of Whales.

VERY little is known about the sleep of whales. They seldom sleep at the surface. Scoresby, speaking of the Greenland whale, says: "Whales are seldom found sleeping, yet instances occasionally occur, in calm weather, amongst ice." I have in my possession a large number of log-books of whaling voyages to the Greenland Sea and do not find a single example recorded. The recently published log-books of Capt. Scoresby, senior, tell the same tale.

Years ago I made a number of voyages to the Greenland Sea with my father, the late Capt. Gray, of Peterhead. On one occasion when we were amongst the ice, and it was my duty to be in the crow's nest, I discovered, with the aid of a telescope, a dark stationary object in the water a few miles away. It proved to be the 'crown' (*i.e.* the highest part of the head) of a Greenland whale asleep. It was on the far side of a large field of ice, and as the wind was light, our ship was two or three hours in reaching it. When we came to it we lowered two boats, one of which pulled towards it and harpooned it.

A few years later we again came across a Greenland whale asleep. This time our ship was anchored to a large floe; the whale was again sighted from the crow's nest, and it fell to my lot to attack it. Pulling for a few miles along the edge of the floe, we came in sight of the sleeping whale. We approached it from behind, as quietly as possible, and before firing the harpoon gun I allowed the boat to run towards it until the bow was over its tail and the stem was almost touching its back. Before the whale left the surface I saw that the harpoon was buried in its back.

I had an excellent opportunity of seeing both these whales. In both cases they lay motionless at the surface from the time they were first sighted until attacked. In both, the 'crown' on which the blow-holes are situated was out of the water, and the back slightly so or awash. Neither of them appeared to be breathing and neither gave any signs of life until harpooned. Their slumber appeared to be very profound.

I remember being told that sleeping whales when suddenly awakened by the harpoon sometimes beat the water with their fins and tail, instead of immediately leaving the surface. For this reason, in the case of a sleeping whale, the attacking boat ran some risk, and in the days of the hand harpoon, when it was necessary to approach very close to the whale, it was usual to awaken it first by tapping on the wood-work of the boat. No harm resulted to the attacking boats in the above instances, but I should have mentioned that the first whale was awakened (but fortunately not alarmed) by a slight ripple that proceeded from the ship's bow before the boat reached it, and that the other did strike the water once violently with its tail but without harming the boat.

It was also my good fortune one voyage to see and harpoon a narwhal asleep, but as the incident is described in the *Zoologist*, 1889, page 100, there is no need to refer to it at length here. As in the Greenland whale, the narwhal when asleep lies motionless at the surface and gives no sign of life. Although these small whales are common amongst the ice, and although it was my duty to spend much time in the crow's nest, I do not remember seeing another asleep on any of my other voyages.

If whales seldom sleep at the surface, where do they usually do so?

The Greenland whalers believed that the Greenland whales sleep under the ice, and that they retired under it at regular intervals for the purpose. Scoresby Senior was of this opinion, and even sent his men on to the ice to awaken them. His celebrated son, a very cautious writer, contents himself with stating: "Some persons are of opinion that whales [*i.e.* Greenland whales] can remain at the bottom of the sea in shallow water, when undisturbed, for hours at a time." According to my father, who had a life-long experience and had opportunities of watching sleeping whales, "the Greenland whale does not require to breathe while asleep and does not do so" (Seventh Annual Report of Scottish Fishery Board, part 3, p. 367).

How are the foregoing observations to be reconciled with what is known of the physiology of whales? What is the explanation?

It is obvious that sleep is as essential to whales as to other animals; that the access of water to the lungs must be guarded against at all costs, and that there is a limit to the time they can live without air. It is also obvious that if whales can remain under water for an hour or more when harpooned and exerting themselves to escape, they can do so for very much longer when their voluntary muscles are at rest. I venture to suggest that whales when asleep awaken to breathe at intervals; that after breathing they relapse into a profound slumber; that the blow-holes are tightly closed during sleep (as indeed appeared to be the case) so as to make it impossible for water to enter the respiratory passages, and that they (the blow-holes) are not necessarily or even usually above water during sleep; that whales usually sleep below the surface hidden from observation and undisturbed by wave motion, but that they rise to the surface at intervals to breathe. In what other way can the facts be explained? I am not prepared to say how long the Greenland whale can sleep without breathing, but it certainly appears to be a long time from what I saw.

I have to add by way of a postscript that we sometimes came across quantities of stringy mucous floating on the surface of the water amongst the ice. According to my father, who called them 'blowings,' they are discharged from the blow-holes of whales, but whether they consist of mucous that accumulates during sleep and is discharged when they awake or is merely evidence of a catarrhal condition, I am unable to state.

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Florentium or Illinium?

In a recent issue of Nature (Feb. 26), and also in *Science*, Prof. W. A. Noyes writes claiming priority for the discovery of the element No. 61 for the American chemists, Messrs. Harris, Hopkins, and Yntema. As an argument in favour of this priority two papers are quoted: one by C. C. Kiess (U.S. Bureau of Standards, 442; 1922; 446; 1923), and the second one by L. F. Yntema, which appeared in 1922 and 1923 respectively.

The first author has accurately studied the arc-spectra of neodymium and samarium, using pure materials supplied by Prof. Hopkins of the University of Illinois. During this research C. C. Kiess found many lines in the visible spectrum common both to neodymium and samarium and of unknown origin. He considers the possibility of these lines belonging to a new element and, following Moseley's rule, since a new element of atomic number 61 should occur between neodymium and samarium, Kiess infers the new element to be No. 61. L. F. Yntema (*Jour. Amer. Chem. Soc.*, 46, 37; 1924) examined the spectra of the same material in the ultra-violet, and he too found five lines not yet classified. Considering then the possibility that these lines could belong to a new element of atomic number 61, he made an X-ray investigation of the *K*-absorption spectra, using de Broglie's method, as well as of the *L*-emission spectra: in both cases he had a completely negative result. The conclusion of Yntema's paper may be quoted: "X-ray analysis of samples from different sources has so far given no evidence of the presence of this element."

In the study of emission spectra in the visible and in the ultra-violet, it is not sufficient evidence for assuming the existence of a new element, to have found lines common both to neodymium and samarium and yet unknown, because the emission spectra of these elements are extremely complicated and uncertain, and also because it is not easy to be perfectly sure about the spectroscopic purity of the material used. These have been the chief reasons why for many years, before Moseley's discovery of the possible number of elements, it was believed that new elements had been discovered only from the fact of having seen new spectral lines. Some of these elements have been really found afterwards, but in this case the discovery did not belong only to those who had noticed the spectral anomalies; the non-existence of other of these supposed elements was proved on further examination.

Indeed, about the homogeneity of the elements composing the old didymium there have been for many years numerous discussions after Auer v. Welsbach succeeded, in 1885, in separating neodymium from praseodymium; many experimenters tried to show the heterogeneity of the new elements. In 1886, Crookes (*Proc. Roy. Soc.*, **40**, 502; 1886) affirms that the two didymia are complex, and so too Demarçay (*C. R. Acad. Sci.*, **102**, 1551; 1886; **105**, 276; 1887), Becquerel (*C. R. Acad. Sci.*, **104**, 777; 1887; **104**, 1691; 1887), G. M. Tomson (*Chem. News*, **55**, 227; 1887), Ksewetter (*Ber. Chem. Ges.*, **21**, 2310; 1888). Crookes and many others, starting from the anomalous behaviour of emission and absorption spectra, believed that didymium should contain at least one other new element. Krüss and Nilson (*Ber. Chem. Ges.*, **20**, 2134; 1887) even stated that didymium and praseodymium were composed of at least nine elements.

In 1913, Moseley's rule removed any uncertainty from these researches, establishing that one and one element only ought really to be found in the didymia earths, and that to this element belonged the ordinal number 61. The merit for this improved prediction should be credited only to Moseley, who defined and circumscribed the field of research.

We believe, then, that the priority in the discovery of element No. 61 belongs instead to those who first had sure data as to its existence, and in similar cases sure evidence cannot be obtained except by means of X-ray investigations. While L. F. Yntema published the negative results of his research in this field, we obtained (X-ray measurements were made by Prof. R. Brunetti) the first photographs of *K*-absorption spectra showing the characteristic band of element 61 and, a few months after, we collected our results in two papers deposited, as *plico suggellato*, at the Accademia dei Lincei. These contained the first certain data, therefore we believe that we should be credited with priority for the discovery.

As regards Prof. Noyes' remark upon the priority of name, we would point out that the name Florentium was given by us in June 1924, a year and eight months before the paper referring to the name Illinium appeared. We are, on the other hand, perfectly in agreement with Prof. Noyes that much additional work has still to be done on the subject, and we hope that the combined effort of researches will, in a short time, bring about the undisputed acceptance of the new element.

L. Rolla.
L. Fernandes.

R. Università Firenze,
Via Gino Capponi, No. 3.
Mar. 21.

Transmission of Stimuli in Plants.

For two writers living in the East to carry on a correspondence in the columns of Nature is a somewhat protracted process, but perhaps I may be permitted to reply to the remarks of Sir J. C. Bose (Nature, Jan. 8) regarding a previous letter of mine (Nature, Oct. 23, 1926).

It is interesting to note that Sir J. C. Bose now apparently accepts the fact, originally demonstrated by Dr. Ricca, that in Mimosa the excitation induced by a flame can be transmitted across a water-gap.

The importance of this fundamental experiment is quite unaffected by any amount of experimental evidence which may appear to show that the phenomena associated with the transmission of stimuli are closely similar in the plant and in the animal. It is not really essential to show that the excitation induced by every kind of stimulus can similarly be transmitted across a water-gap, although, provided that the stimulus can be made sufficiently intense, there should not be any difficulty in affording the necessary proof. It must be remembered, however, that if only a small amount of hormone is set free, it would suffer so much dilution in passing through the water-gap that its stimulating power would be seriously diminished.

Some of the arguments used by Sir J. C. Bose against the transpiration current theory have little force. For example, he states that the impulse should only travel upwards in the same direction as the ascent of sap. Movement in either direction is readily explained by the generally accepted theory of the ascent of sap put forward by Dixon and Joly, and can easily be demonstrated by cutting the plant under stain. At the same time it must be admitted that, although Dr. Ricca's theory undoubtedly explains many of the normal instances of conduction in Mimosa, it does not afford a complete explanation in every case. In submerged shoots, for example, where the transpiration current is almost negligible, stimuli may be conducted through long distances in the stem at a rate of more than 200 cm. per minute. In a paper which I hope will be published early this year, I have suggested that in such cases the transport of the stimulus takes place as a result of the contraction of highly turgid cells. At the point where the stimulus is applied, certain of the cells contract and liberate a stimulating substance. This affects neighbouring cells, which in turn liberate more of this substance, and so the process goes on. For the experimental evidence on which this theory is based, I must refer Sir J. C. Bose to the complete paper, but I may mention that it appears to afford an explanation for those cases where, as already pointed out by Mr. R. Snow, the transpiration current theory is inadequate.

The evidence which Sir J. C. Bose has brought forward in favour of his own theory is well known and is extremely interesting. Even if one holds the view that the conduction of stimuli in Mimosa takes place apart from any nervous mechanism, it is still necessary to consider certain of the phenomena associated with electrical stimulation. It seems probable that these may be explained in other ways, although, at the present state of our knowledge of the factors involved, this may be difficult. If, however, it is finally proved that there are certain facts which cannot be explained by any other hypothesis, then, and then only, shall we be justified in accepting a nervous mechanism as *one* of the methods by which stimuli are transmitted in plants.

Nigel G. Ball.

University College, Colombo,
Feb. 3.

River Pollution and the Acidity of Natural Waters.

In "Fundamental Problems relating to River Pollution" (Nature, Mar. 26, p. 463), Mr. H. W. Harvey mentions the probable effect of the hydrogen ion concentration on river flora and fauna, and suggests that possibly *p*H 5·5 is a critical value.

It seems probable that, as regards fish life, acclimation may be an important factor and that possibly fish habituated to acid conditions may readily tolerate a degree of acidity which would be very deleterious, if not fatal, to others reared in, and accustomed to, neutral and alkaline water. The burns and lochs of the Scottish highlands are largely in peat and igneous rock; limestone exists only in small areas and in isolated districts. The water supply coming from peat is essentially acid in character, and in surface drains and pools the *p*H value may be no more than 3 or 4; clear springs coming through the 'pan' under the peat have been found to be *p*H 4·5, while in a peat surrounded loch of the same water value trout, averaging ¾ lb. in weight, flourished. Both trout and salmon will leave a burn having water of *p*H 6 for another and smaller of *p*H 5 in order to spawn. In similar peat districts with a limestone formation, however, the acidity is lessened or neutralised and the burns vary from *p*H 6 to *p*H 7·5.

Such acid conditions as prevail in the typical peat district may perhaps affect the nature of the flora and may possibly restrict the fauna, but both trout and salmon parr can, and undoubtedly do, thrive in water of *p*H 4·5 to *p*H 6. W. J. M. Menzies.

Fishery Board for Scotland,
Edinburgh, Mar. 30.

A Useful Electric Cell.

Take a glass vessel, a porous cell, a zinc rod and a carbon plate, such as are used in the ordinary Leclanché cell (a circular glass vessel of the same capacity is better). Prepare a solution of 20·4 grams of potassium dichromate and 87·4 grams of sulphuric acid (sp. gr. 1·75) in 350 grams of water and pour it into the glass vessel. Place the carbon plate in this solution. Fill the porous cell with a solution of 14·5 gm. of ammonium chloride in 200 gm. of water and place it in the glass vessel containing the dichromate solution. The amalgamated zinc rod is placed in the porous cell. The E.M.F. of this cell is 2 volts. The internal resistance is about 0·6 to 0·8 ohm. When continuously used, it gives a constant current for more than 12 hours, and the E.M.F. remains unchanged. The rate of dissolution of zinc (when a rod of zinc is used) is only 2·5 gm. in 12 hours, while in the bichromate cell the rate is 12 gm. When used intermittently, the cell remains efficient for more than three weeks. S. L. Jindal.

D.A.V. College Laboratory,
Cawnpore, Feb. 24.

Biological Fact and Theory.

Prof. Walker in Nature of Mar. 26, p. 456, introduces personalities into his reply to my letter. In the circumstances, I do not wish to continue a discussion intended to deal with the purely scientific issue of whether Prof. Nöel Paton's attack on accepted genetic theory was justified.

I would, however, like to repeat the statement with which I began, namely, that the progress of biology in Great Britain is being retarded by the failure of specialists in its various branches to appreciate the bearings of work done in other fields than their own. With regard to the specific point at issue, Prof. Walker writes that he has watched "often with amazement, sometimes with amusement," the attempts of geneticists "to make the 'neo-Mendelian' 'laws' agree with the results of breeding experiments." What must a physicist think of biology and biological theory when he reads this? In physics, at least, the prime aim of the man of science is to make his theories fit the facts of Nature. One's comfort is that, with few and negligible exceptions, the whole body of those engaged upon genetical research are actually employing the conceptions and theories which I enumerated, and which Profs. Paton and Walker repudiate, as a means to the discovery of new and fruitful facts. Julian S. Huxley.

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

The Development of Natural History Museums.

Opening Nature of April 16 at p. 551, I am astounded to read: "What has the Natural History Museum . . . done to make Darwin's . . . discoveries current amongst his own people? . . . Nothing! Except for a few isolated exhibits, shown almost in holes and corners. . . ."

When you favour this Museum with a visit you will doubtless observe the statue of Darwin in the place of honour, looking down on a Hall in which are conspicuous cases illustrating such subjects as variation under domestication and in Nature, protective coloration, mimicry, intergradations between species—cases which, I may remark, set an example to the world.

If you will then do me the honour to enter the Geological Department, the very first label (a large one, next the door) you will find explains evolution in Proboscidea, while the relevant specimens face you on entry. If you will kindly follow me into Gallery VIII you will speedily be brought up by an exhibit in a large central case elucidating evolution, convergence, and adaptation in some stalked echinoderms; farther on is one illustrating evolution in the sea-urchin Micraster. The cases devoted to Polyzoa illustrate growth and evolution in a colonial organism. Returning, you cannot miss the classical instances of the Steinheim Planorbis, the Viviparus of Slavonia, and the Melanopsis of Hungary.

You could see more examples in other galleries, but that is enough for one visit. Let me, however, remind you that similar exhibits prepared and arranged by the staff of the Museum have been shown at the White City and at Wembley in several years. Guides to the Geological Department have been praised for their connecting thread of evolutionary philosophy. Towards that philosophy of recent years one of the most important contributions has been the catalogue of fossil Polyzoa, notably the volumes by Dr. Lang.

With much that you say I am in hearty agreement. But if you wish for reforms you will not get them if you begin by antagonising those who are working all day and every day to put those reforms into actual practice. Let me assure you that the combination of accuracy and order with imagination and breadth of view is not impossible, even in a museum official: certainly it should not be impossible in a leading article of our chief scientific paper. F. A. Bather.

Natural History Museum.

Dr. Bather's comments surely support our plea for a more educative and effective arrangement of exhibits of fundamental biological importance. Under his skilled guidance several such exhibits may be discovered, but to the ordinary intelligent visitor, who may lack such guidance, they are for the most part lost in the systematic arrangements to which they are subordinated, and if discovered can make only an isolated and non-cumulative appeal. Our comments, however, were not meant as hostile criticism, for probably as much has been accomplished as the conditions allow; we endeavoured to indicate that, under present conditions, it is difficult or impossible to keep the exhibits abreast of the modern scientific and educational outlook, and that this, with other factors, pointed to the desirability of an inquiry into the position as a whole.

The Writer of the Article.

Proposed Review of the Mineral Resources of the British Empire.[1]

By Sir Thomas H. Holland, K.C.S.I., K.C.I.E., F.R.S.

In general terms the mineral production and metallurgical activities of the British Empire are already known; but no one has measured a base-line with sufficient precision for projecting with confidence the probable effects of further prospecting and future exploitation, coincident with the growth of metallurgical science, not only on the Empire as a whole, but also on each independent unit of Imperial territory.

War stresses demonstrated that the Empire is in reality a *political* unit, and, because of the strength and efficiency of the navy, its resources were then worked successfully as a *military* unit. But we all know that it is still far from being an *economic* unit, and it is conceivable that military developments in the near future may make it difficult, perhaps impossible, for the mineral resources of all parts to be assembled for any purpose.

Great Britain is at present the chief manufacturing section of the Empire, and it consequently will remain for many years to come the principal arsenal and base for stores of most sorts. In order to be precise regarding the mineral supplies that can be relied on in any contingency, it is necessary to have exact details regarding the resources of each isolated unit of territory; for there are many essential munitions—animal and vegetable as well as mineral—that Great Britain itself cannot supply, either in the right kind or in the requisite quantity.

In mentioning military requirements, I do not refer to munitions in the narrow popular sense as lethal munitions. They form only a fraction of the supplies that are essential to an army in the field. What a soldier wants on active service under modern conditions may differ largely in form, but agrees very nearly in substance, with what he wants during ordinary peace-time civilised life; and whilst the A1 extract of young men is in the field, the larger insoluble residue of the population insists on its accustomed food, clothing, business, and amusements at home. The maintenance of the *morale* of a modern civilised community requires of raw materials and manufactured products the same kind that is necessary for the fighting army, but in a much larger quantity.

Thus, the economic and military problems of supply are not very different in nature: the fighting strength of a nation is limited by its industrial strength, and its industrial existence depends on the maintenance of a sufficient supply of raw materials.

There are, however, some raw materials that a country, for commercial reasons, often neglects under normal industrial conditions: its requirements of the articles manufactured from such materials can be obtained from other countries ordinarily in circumstances so favourable that the local establishment of manufacture may not be worth while commercially. For example, before the War, the wolfram deposits in South Burma were worked mainly by British companies, but practically the whole of the mineral went to Germany for the manufacture of tungsten; and then, although Sheffield occupied about the front place among manufacturers of high-speed tool-steel, its tungsten was obtained from Germany. Attempts made before the War to smelt tungsten in Great Britain had not been commercially successful; and at the time, that seemed to be a small matter, for we readily obtained all the tungsten we wanted from Germany, and Germany obtained all the ore she wanted from British territory. With the War, however, two inconveniences followed in order. First, we had to devise our own plant for smelting tungsten, and, under compulsion of necessity, we succeeded before the middle of 1915. Second, Germany found herself without tungsten ore, and that proved naturally to be more serious; for, although she obtained some molybdenum from Norway as a substitute, it was not exactly the same thing; and even this new move was countered by British purchases of the Norwegian output of molybdic ores.

Three lessons can be stated at once from this example:

(1) Whilst the military authorities of Britain may rely on our ordinary industrial complex for nine-tenths of their requirements, it is their business to see that the essential tenth is secured, and they cannot identify that tenth unless we provide full information regarding our resources.

(2) It is *important* to be sure that we can smelt as well as mine an essential ore; technical progress in mining and metallurgy in Great Britain must keep pace with the prospective developments of other nations.

(3) It is absolutely *essential* to be sure that we can get access to supplies of the necessary ores.

Germany rushed into a war that she expected to be over in a few months; she made the mistake of thinking she had sufficient reserves of tungsten ore. We made no mistake in that direction; for apparently the British General Staff did not think at all of a matter so small. Between 1911, when war was seriously threatened, and 1914, when it became unavoidable, efforts were devoted with conspicuous success to the training of an army that gave a new meaning to the word ‘ contemptible ’; but who thought it necessary to provide for the smelting of an inconspicuous metal like tungsten, either in Britain or in British territory ?

I have quoted the recent War conditions as the basis for our lesson, because the results were sharp and demonstrable, as well as still fresh in our memories. The way in which Germany was embarrassed by the blockade is a warning of what may happen if, by more effective means for cutting communications in the future, Britain becomes isolated, or, more likely, one of the outlying Dominions becomes blockaded in a future war.

Great Britain is so obviously unable to provide many essential raw materials in sufficient quantities, even under peace conditions, that to show by a

[1] From a paper read on April 21 before the Institution of Mining and Metallurgy.

detailed survey that she may be short of another mineral or two will not add much to the responsibility; but it is important to make estimates of the resources of each Dominion, and, separately, for groups of them and the Colonies—the minerals that each can mine and smelt, the ways in which each can supply the needs of others, the kinds that each can draw from adjoining foreign territory, and the amounts of the smaller, but necessary, mineral products that each should accumulate as stocks to draw on in a temporary emergency. Most nations carry stocks of gold and some of silver, but why not antimony, nickel, tungsten, and quicksilver as well? If isolated, could any Dominion, except Australia, meet its requirements in antimony? Could any country, except Canada, provide enough nickel? Could any part of the British Empire raise its own mercury? Yet, it would be less expensive to accumulate stocks of these sufficient for a few years' requirements than to buy a battleship; for a battleship is expensive to maintain, it gets quickly out-of-date, and it would be of little use in any event without supplies of most of these metals. Stocks of some metals are desirable also from the economic point of view, as they can be used to prevent speculative changes in prices.

Production figures give us a partial idea of resources; but something far more complete than this is necessary in devising a fiscal policy within the Empire itself, and *vis-à-vis* the rest of the world. The major mineral products are naturally those of most public concern from the economic point of view, but what we regard as minor and accessory minerals in times of peace may become vitally, or, more correctly, fatally, important under conditions of war.

Statistics of current production form an essential basis on which to design an economic policy, but they are unsatisfying in two important respects: (1) They do not reveal a country's resources in those minerals that could be exploited if and when necessary, but are not now worked under those commercial conditions that have developed by existing fiscal regulations; and (2) they do not give us an idea of the reserves available for future exploitation.

No other country has been more thorough than the United States in accumulating and publishing figures for production. Yet, in spite of these advantages, the international, and consequently political, aspects of mining and metallurgy, which arose directly from war and post-war conditions, remained to a certain extent neglected. In 1921 the Mining and Metallurgical Society of America combined with the American Institute of Mining and Metallurgical Engineers to establish a joint committee, under the chairmanship of Prof. C. K. Leith, to survey the problems of industrial preparedness in the United States; and this Committee on Foreign and Domestic Mining Policy first established a series of propositions, to be tested by a special sub-committee, for each important mineral.

The propositions [2] adopted by the Committee are summarised as follows:

[2] "International Control of Minerals," New York, 1925, p. 7.

(1) The international movements of certain minerals are inevitable, and although they may be hindered by fiscal barriers, they cannot under civilised conditions be stopped altogether. It is thus considered to be foolish to attempt by artificial restrictions to make any country self-contained: each should be allowed to benefit by drawing on the special advantages of others.

(2) Thus, in order to reduce transport expenses, concentration generally, followed according to circumstances by smelting or fabrication, should be accomplished near the source of supply.

(3) Prof. Leith and his colleagues plead for freedom for all nationals to prospect and exploit, and they urge that laws granting concessions should require that licensees of prospecting rights over large areas should be compelled, within reasonably short time, to narrow their claims for mining leases to areas that can be exploited effectively.

(4) Pressure on backward governments may be necessary to prevent them from shutting out those who are willing and able to develop mineral resources, of which they have surplus supplies, whilst industrial countries are suffering from deficiency; but any government using such pressure should observe the principle of the open door for all nationals.

(5) Government—that is, the United States Government—should improve the official intelligence agencies in foreign lands and so assist Americans with the information and help necessary for mineral enterprise abroad. There should be more attempts to obtain and correlate information regarding the world's resources in important minerals.

(6) The committee classified the known mineral deposits of the United States into:

(*a*) those that are obviously in quantities large enough to spare a surplus for export;

(*b*) those that just meet domestic needs, without excess or deficiency;

(*c*) those that exist in noticeably inadequate amounts; and

(*d*) those that the United States lack almost entirely.

The American assumption that we have nearly full knowledge of the distribution of mineral deposits of importance may be approximately accurate for the United States, but it would be unwise to apply it to Canada, to our African colonies, or to Australia. Possibly new discoveries in these areas will not disturb the world's supply of coal, manganese, iron ore, or petroleum in the near future, but it would be unwise to add copper and other relatively cheap base metals; in any of these partially explored areas there may well be deposits large enough and rich enough seriously to divert the present streams of the metal trade. Even the new discoveries of manganese on the Gold Coast threaten to change the source of supply of these ores.

However, it is useless to investigate our resources in minerals, and futile to discuss schemes to secure local smelting and refining, if the laws which control the grant of concessions for prospecting and mining add unduly to the cost of exploitation.

The conditions for mining change with the increase of transport facilities, with the development of new local markets, and with the growth generally of industries and technical science. Facilities of the kind that are necessary to encourage enterprise should thus be reviewed at reasonable intervals. No rules can hold good for longer than a few years, but their revision at frequent intervals tends to unsettle the confidence of business men, which of all bad policies is the worst.

It is the business of a mining company to make as much profit as possible out of a mineral deposit during the period of its mining lease; it is the business of government to safeguard a national asset of vital importance which cannot be replaced or renewed. But it is better for a country that its mineral deposits should be worked than that they should be left lying idle. The mineral policy of a government is thus the choice of a judicious mean between extravagance and conservatism; and, as the values of minerals vary with the industrial development of a country and that of the countries with which it is in trade communication, this judicious mean will gradually shift its position between the two extremes. Thus, the whole problem of framing and working a mineral policy for a large State is a choice of the judicious mean in all things—rents, royalties, periods of tenure, and size of areas leased.

There is a fundamental difference between State ownership of mineral rights and State ownership of mines, but there is a prevalent tendency, and therefore danger, of lumping both together as similar forms of Socialism, thus bringing them both into the arena of party politics. Legal doubts about security of tenure, absence of clear title to surface rights, local variations in length of lease and rate of royalty, the independent necessity of acquiring wayleaves and water-rights, are frequent accompaniments of the private ownership of minerals, and they all adversely influence the financier who is asked to underwrite a mining enterprise in an area in which he is not otherwise interested. The end effect of these disadvantages is a handicap to the enterprise, which, like every other item of cost in mining, results in a loss to the State of some part of its mineral reserves.

The mining industry differs fundamentally from others: mineral deposits cannot be transplanted from one country to another; no nation, not even the British Empire, and much less any Dominion, is self-contained; minerals are essential for the maintenance of our commercial life and for military security; yet they can be worked once, and once only, in the history of a nation; the necessity for exchanging minerals between the Dominions involves the question of their fiscal interrelations; the necessity of exchange with other nations affects our foreign relationships. The importance of being safeguarded in mineral resources is only in a degree greater than the importance of being able to smelt our own ores.

There are good reasons, therefore, for classing mining with most of the public utility services, that is, as an industry that might be safeguarded by State action, without the intervention of party politicians or fear of doctrinaire Socialism.

Official and State-aided organisations already exist for the collection and publication of mineral statistics, but institutions of the sort, in order to retain the public trust in them for reference purposes, properly avoid the discussion of those conditions that affect finance and therefore the progress of exploitation. There are so many phases of the two complementary industries of mining and metallurgy which require a wide range of specialists for judicial consideration, that the task of making a survey of our mineral economics might be safely entrusted to those institutions at home and in the Dominions Overseas that have joined in organising the Empire Mining and Metallurgical Congress and Council. It is suggested that these institutions be invited forthwith to inaugurate special surveys for their appropriate territorial units, each being left to follow the plan that appears to it most suitable to the special conditions of its own Dominion and State.

The National Museum of Wales.

THE formal opening, by their Majesties the King and Queen, of the National Museum of Wales, took place at Cardiff on April 21, at a ceremony characterised by great dignity and splendour. Fifteen years ago their Majesties laid the foundation-stone of the building, and, in fulfilment of a hope expressed on that occasion, they graciously consented to open the first portion of the institution to be completed. Representatives from all parts of the Principality, embracing every side of the national life and thought of Wales, were present, while Mr. C. Tate Regan, Director of the British Museum (Natural History), and Mr. J. Charlton Deas, President of the Museums Association, represented the national and public museums of Great Britain.

Their Majesties were met on their arrival by Lord Kenyon, President of the National Museum of Wales, Lord Pontypridd, Lord Mostyn, Lord Treowen, Lord Aberdare, Sir William Reardon Smith, the Treasurer of the Museum, and Dr. Cyril Fox, the Director. Mr. Dunbar Smith, the architect of the building, was presented to the King and asked His Majesty's acceptance of a mallet with which to perform the ceremony. Their Majesties then proceeded to the Entrance Hall of the building where the main ceremony took place. A loyal address on behalf of the Court of Governors and of the Council of the National Museum was read by Lord Kenyon and replied to by the King, after which the members of the Council of the Museum were presented to their Majesties. In the course of his reply to the address the King paid a well-merited tribute to the high ideals and achievements of the Museum, to the liberality of its benefactors, and to the wise planning and skilful designing of the building. He spoke of the valuable help the Museum could render by cultivating in the Welsh people a sense of beauty, a love of national scenery, and a pride in their nation's historic past, and by kindling a spirit of loyal service to its future welfare.

Under the guidance of the President and Director of the Museum, the King and Queen then made a tour of inspection of the building, in the course of which the King unveiled three tablets naming the Lord Glanely Gallery, the Pyke-Thompson Gallery, and the Reardon Smith Gallery, commemorating the principal benefactors.

Before and during the ceremony a delightful programme of music, under the direction of Sir Walford Davies, Mr. Warwick Braithwaite, and Mr. W. M. Williams, was given by a mixed choir of 300 voices drawn from choral societies all over Wales, the Cardiff Musical Society, the Romilly Choir, and the Cardiff Orchestra of the British Broadcasting Corporation. The occasion was a most auspicious one for this great Institution and a fitting inauguration for work of such first importance as that which it is seeking to do.

The idea of a National Museum for Wales was born more than thirty years ago, but the practical commencement of the scheme may be said to date back to 1903, when a resolution approving the scheme was moved in the House of Commons by the late Mr. William Jones, seconded by Mr. (now the Right Hon. Sir) J. Herbert Lewis and supported by Sir Alfred Thomas (now Lord Pontypridd). In 1905 a Special Committee of the Privy Council decided upon Cardiff as the most fitting locality for the Museum, and the Cardiff City Council allocated the magnificent site of five acres in Cathays Park on which the building is now in process of erection. The then existing Corporation Museum in Cardiff formed the nucleus of the national collection.

The Royal Charter establishing the Museum was granted in 1907, and in 1908 the first Director, the late Dr. W. Evans Hoyle, was appointed to the post. With characteristic energy, Dr. Hoyle threw himself into the work of preparing details of the requirements for the proposed building, and in 1910, after open competition, the design of Messrs. Smith and Brewer was accepted out of 130 competitors. The foundations of the south front and parts of the east and west wings were commenced in 1911 and the foundation-stone was laid by the King and Queen in 1912. The War, unfortunately, necessitated the complete suspension of building operations when only about one-half of the superstructure was completed, and the adverse conditions of post-War years, with the increased cost of building which accompanied them, has delayed the completion of these first portions of the Museum until this year. Even now it has been possible to do so only through the magnificent gift of £21,000 from Sir William Reardon Smith, the Treasurer of the Museum, which enabled the Museum authorities to appeal to the people of Wales for funds to complete the superstructure commenced fifteen years ago.

The National Museum of Wales is one of the best-designed Museum buildings in existence. The wide knowledge of museum construction and requirements possessed by its first Director, together with the skill of a most understanding architect, have combined to produce a building of great beauty, strikingly individual in character, yet dignified and nobly proportioned, in which both exhibition galleries and workrooms have been successfully planned on the lines of the most modern ideas of museum construction.

FIG. 1.—National Museum of Wales, Cardiff. Front view.

The entrance hall, the scene of Thursday's historic ceremony, is one of the chief glories of the building. It consists of a central octagon roofed by a lofty dome, with lateral bays extending the full width of the south front. The beauty of its great interior is of simple character arising out of structural necessities, fine proportions, adequate and well-placed lighting, and sound, beautiful craftsmanship.

The building opened by the King and Queen last Thursday represents little more than a quarter of the contemplated scheme. In it, however, separate galleries are available for zoology, botany, geology, archæology, oil paintings, water colours and prints, while the lateral bays off the entrance hall are to be devoted to sculpture, so that it is possible to lay down the general lines on which all sections of the institution will be developed.

The completion of this first portion has already had a stimulating effect. Lord Buckland has made a donation of £35,000, and Mr. Lewis

Lougher, M.P., one of £5000 towards the building fund, and, as these donations will be augmented by equal grants from the Treasury, it is hoped to make an early start with a further portion of the east wing, which will include a much-needed lecture theatre.

The purpose of the Museum has been aptly stated in the phrase, "To teach the world about Wales and the Welsh people about their own Fatherland," and it seeks to fulfil this purpose in a large variety of widely spread activities. In the first place, it is actively engaged in the collection and preservation of all kinds of material bearing upon the archæology, art, history, and natural history of the Principality, and presenting to the public a selected series of objects from this material in readily intelligible and attractive form, from which the story of the country in all its aspects can be studied. Secondly, it is doing a great deal of valuable educational work by means of lectures and demonstrations to schools, colleges, societies, and institutions of all kinds throughout Wales, and by an organised system of loan collections, which are sent out to all parts of the country, especially to national organisations such as the Royal Eisteddfod and the Royal Agricultural shows. It encourages and works in close co-operation with local museums in all parts of Wales and helps them by means of loans and curatorial assistance. Through the medium of its printed guides and other publications, information regarding the contents of the Museum in the light of recent research is provided in convenient, popular, and strictly scientific form. It is a valuable adjunct to the University of Wales, especially to the University College of Cardiff, the students of which make regular and frequent use of its resources in the prosecution of studies covered by its activities. Lastly, it is itself a research institution, and most valuable work has been done by the staff. Reference need only be made to the important excavations undertaken at Caerleon, Caerwent, and other important archæological centres in Wales under the auspices of the Museum, to realise that this important aspect of Museum work has been given a conspicuous place in its policy. Equally important, though perhaps less well known, research has been accomplished on the natural science side.

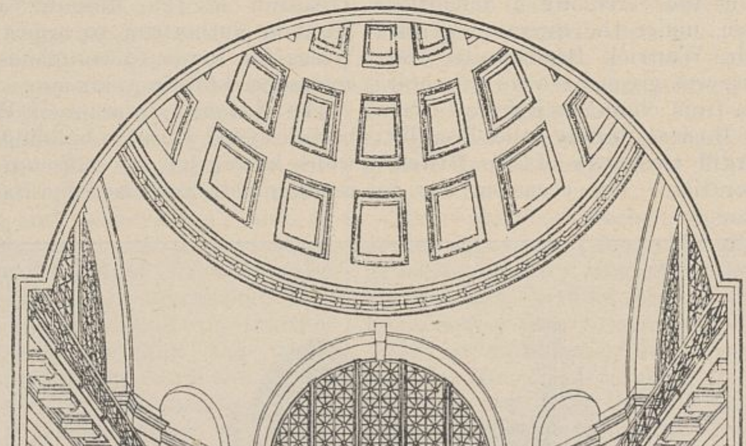

Fig. 2.—Entrance Hall of National Museum of Wales.

The Museum of Wales owes much to its first director, Dr. W. Evans Hoyle. It was he who conceived the broad lines of general policy on which the work of the Museum is based, and it is to his ripe experience of museum matters that the success of the institution as a museum must be attributed. His successors in office, Dr. R. E. Mortimer Wheeler and Dr. C. Fox, have continued the tradition established by him. Under direction so able and with purpose so lofty, the success of the museum as a national institution, reflecting national life, ideals, and thought, is assured.

It is to be hoped that the stimulus of last Thursday's ceremony will result in the speedy completion of the whole building, so that the work of the Museum may go forward unhampered and unimpaired for want of adequate accommodation and facilities.

Obituary.

PROF. C. S. SARGENT.

FOR more than half a century the name of Prof. Charles Sprague Sargent, Director of the Arnold Arboretum, Harvard University, has been familiar to all who have interested themselves in the scientific cultivation of trees, and we learn with deep regret that he died on Mar. 22 at his home at Brookline, Jamaica Plain, near Boston, Massachusetts.

Prof. Sargent was a descendant of an old Gloucestershire family and he was born at Boston on April 24, 1841. After graduating at Harvard in 1862, he spent three years in the Federal Army, retiring with the rank of brevet major in 1865. He then spent several years in European travel, and afterwards settled down to botanical study at Harvard, devoting his time very largely to the study of the native trees and shrubs of North America. In 1872 he was appointed Director of the Arnold Arboretum, which was at that time in course of formation in connexion with Harvard University. He was connected with that institution until the day of his death, and it was entirely due to his personality, knowledge, energy, and liberality that the Arnold Arboretum attained the proud position it holds in the scientific world to-day.

In addition to forming a very complete collection of trees and shrubs hardy in this particular locality, Prof. Sargent wrote or edited numerous works on trees and shrubs. His "Silva of North America," published between 1891 and 1902, in fourteen quarto volumes, is a monumental work, and will long remain the standard work on North American trees. His connexion with botanical exploration in China and Japan is well known to dendrologists. In 1892 he undertook a prolonged journey in Japan in order to study the native trees, and the result of his observations became known when he published his "Forest Flora of Japan" in 1894. He afterwards took a prominent part in the organisation of several of Mr. E. H. Wilson's journeys of botanical exploration to China, Japan, and other countries, and he edited "Plantæ Wilsonianæ," an enumeration of the woody plants collected by Wilson in China during his two previous expeditions, which was published in 1913. In addition to purely botanical knowledge Prof. Sargent also possessed a thorough understanding of the cultural requirements of trees and their disposal for landscape effect. He was always ready to impart his knowledge, and was particularly generous in the distribution of plants to other institutions and individuals in his own and foreign countries.

Prof. Sargent was a constant correspondent with the Royal Botanic Gardens, Kew, and was always ready and anxious to share with Kew any of the interesting plants which were collected through the agency of the Arnold Arboretum in China, Japan, or elsewhere. He paid several visits to Great Britain and always spent much of his time at Kew. In addition he paid visits to see all the more interesting specimens of trees and shrubs which flourish in Great Britain but may not be hardy in the more severe climate of eastern North America. His death is a great loss to botanical science both in America and in Great Britain, where he had many friends.

IT is with great regret that we receive the news of the death of the distinguished French man of science, Daniel Berthelot. The son of Marcelin Berthelot, the centenary of whose birth is being celebrated in the present year, Daniel Berthelot showed much of the originality and width of outlook of his illustrious father. After periods of service at the Sorbonne and the Collège de France, he became professor of physics at the École de Pharmacie, and it was in his laboratory at Meudon that he made most of those discoveries and researches in the fields of pyrometry, temperature scales, gas densities, and the chemical effects of ultra-violet light for which his name will be held in remembrance. The famous characteristic equation which he introduced has become second in importance only to that of Van der Waals, and is more accurate than the latter within its legitimate field of application. Daniel Berthelot laid the foundations of accurate gas thermometry and the physical methods of determining molecular and atomic weights which have closely rivalled, if not even excelled, the most accurate procedure of gravimetric analysis. In the field of chemistry his most notable discovery was probably the production of formaldehyde when a mixture of water vapour and carbon dioxide is exposed to ultra-violet light, and of formamide when carbonic oxide and ammonia are similarly irradiated. These syntheses lie at the foundations of biochemistry.

THE issue of the *Physikalische Zeitschrift* for Feb. 1 contains a notice of the life and work of Prof. Des Coudres of Leipzig, who died on Oct. 8, written by his colleague, Prof. W. Wien. Des Coudres was born on Mar. 13, 1862, at Veckerhagen, near Göttingen, of a family which had left the Spanish Netherlands during the religious wars. He was at school at Cassel until 1881 and then studied in succession at Geneva, Leipzig, and Berlin. He took his doctor's degree under Helmholtz at Berlin in 1887 and in 1889 went back to Leipzig as assistant to Wiedemann. In 1897 he was appointed professor of applied electricity there, but in 1901 went to Würzburg as professor of theoretical physics and in 1903 succeeded Boltzmann at Leipzig. He never married, and was content to live for twenty-three years in his rooms in the attic of the Physical Institute. He was fond of travelling, particularly in warm sunny countries. He is probably best known for his work on the speed of cathode rays.

WE regret to announce the death of Dr. S. W. Richardson, formerly principal and professor of physics at University College, Southampton, on April 10, aged fifty-seven years.

News and Views.

In a paper entitled "Observations upon Mining Law in the Empire," read before the Institution of Mining and Metallurgy on April 21, Mr. Gilbert Stone introduced a subject of vital importance to the mineral industry. Laws and regulations frequently contain provisions that tend to hinder the industry they seek to assist; this may be due to the operation of changed local conditions; it is obvious that regulations suited to a new and undeveloped territory become unsuitable when the region has been occupied by a rapidly growing agricultural community or by large industrial centres. On the other hand, the law may be radically wrong: China, with its great resources, has little mineral development because the law and customary rules—which permit the pursuit of minerals across anybody's land, without compensation or regulation, but only by a special caste, whose members must be bought out—operate to prevent modern methods of development; capital cannot be attracted in such circumstances. That is an extreme case, but cases could be cited from parts of the British Empire of laws that have prevented or seriously hampered either prospecting or development.

While admitting that local differences must be respected in the framing of mineral law, it is clear there is too much diversity in the regulations for prospecting, in the charges for rents and royalties, and in the method of their determination; also in the mode of staking a claim and obtaining a title, and there are still regions where it is uncertain in whom the mineral rights reside. In the British territory in Africa alone, there are twenty-one different codes of mining law. Mr. Stone considers that our mining codes should make matters easier for the pioneer prospector, for a single discovery may alter the whole history of a country in which it is made. In order to encourage the free flow of capital, everything should be done to establish clear and unimpeachable titles, for suitable terms. The short-term lease may be very wasteful of the country's resources. The Advisory Council on Minerals of the Imperial Institute, to which Mr. Stone is legal consultant, is performing a valuable function in assembling for comparative study and analysis the diverse forms of mining law now current.

To enable the manufacturer and the tax-payer to appreciate what the State-aided research associations in Great Britain have achieved in the first few years of their existence, the Department of Scientific and Industrial Research has just published a report on "Co-operative Industrial Research" (London: H.M.S.O. 9*d*. net), which gives an account of their activities, grouped under results of commercial value and indirect benefits to industry. Another section of the report deals with the measure of support which each association has been given by the industry it serves. Presumably the report is intended to arouse public opinion to the necessity for industrial research, but it is an uninspiring publication. The information given is scanty in the extreme, the research needs of the industry are never clearly stated, and very few of the problems which are absorbing the attention of the scientific staffs are mentioned. Many of the so-called results recorded cannot be classed as research: they merely serve to display the barrenness of ideas and crudities of practice which characterise many British manufacturing firms. The report states that "many of them [the research associations] have directed their attention to removing defects and avoiding waste: it may be said that there is a general tendency to seek rather to improve the efficiency of existing industrial processes than to devise radically new processes or products." The impression the report is likely to produce on the tax-payer, and even on the manufacturer who knows what real research means, is that the direct and indirect benefits accruing to industry as the result of the activities of the associations have been bought very dearly. The photographs of buildings and laboratories published in the handbook will probably tend to reinforce that impression rather than to remove it.

This week is marked by the centenary of the birth of Capt. John H. Speke, African explorer and discoverer of the source of the Nile. Speke was born near Ilchester in Somersetshire on May 4, 1827. Educated for the Indian Army, whilst on service his inclinations were strongly set towards the exploration of central equatorial Africa. After soldiering work in the Crimea, the opportunity came in 1856 of associating himself with Richard Burton in an official expedition to central Africa, the chief objective being the traditional equatorial lakes. On July 9, 1858, Speke himself left the base Kazé, marching north, and on July 30, 1858, after an arduous journey, reached the great expanse of water named by him Victoria Nyanza. His unalterable belief that he had discovered the source of the Nile was contested by Burton. On May 8, 1859, Speke arrived in England. His ardour undiminished, he immediately engaged in preparations for a supplementary expedition, avowedly for the purpose of establishing the truth of his assertion that Lake Victoria Nyanza would eventually prove to be the source of the Nile. In this project for confirmation he had the full support of Sir R. Murchison and the Royal Geographical Society. Speke left Zanzibar in September 1860, accompanied by a fellow explorer, James A. Grant (also born in 1827). The object was ultimately achieved. The point where the Nile leaves the Victoria Nyanza was named Ripon Falls. The fact that the Nile had been traced to its source created a profound sensation when communicated at a meeting of the Royal Geographical Society on May 11, 1863, and Speke's book, "Journal of the Discovery of the Source of the Nile," published in 1863, was widely read. Murchison stated that in discovering the source reservoir of the Nile, Speke had succeeded in solving the "problem of all ages."

Sir Christopher Wren and his scientific contemporaries, Elias Ashmole and Dr. Robert Plot, are to be commemorated on Tuesday, May 17, at Oxford, by the unveiling of three armorial windows in the Old Ashmolean Museum by the Chancellor of the University, Viscount Cave. The window to Wren has been appropriately presented by the fellows of the Royal Institute of British Architects, who held a most successful meeting in Wren's Sheldonian Theatre in the summer of 1925, and it is expected that the president of the Institute will attend in person to pronounce an eloge on his great predecessor. The windows to Ashmole and Plot are presented by the colleges with which they were respectively connected while in residence in Oxford. By the addition of these windows to the window to John Tradescant, described in these columns on Dec. 4 last, not only is a very beautiful decoration being added to the fine staircase of the Old Ashmolean Museum, but also appropriate though tardy recognition is being made to that singular group of seventeenth-century pioneers who by their joint endeavours provided England with her first public museum of natural history. A coloured drawing of the new windows is being issued with the May number of the *Architectural Review*.

With reference to the recent notice of the centenary of death of Ernst Chladni, and of his work (Nature, April 2, p. 503), a correspondent writes that the vibrations of metal or glass, which under certain conditions produce the so-called "Chladni's figures," would seem to have engaged the attention of the versatile Robert Hooke when in charge of experiments conducted at Gresham College in the early days of the Royal Society. It is recorded that on Mar. 30, 1671, at the Royal Society, Mr. Hooke produced his glass-bell with flour in it, to show to the eye that, according to the several strokes or pulses made upon the glass, the air thence receives as many impressions; it being manifest by this experiment that as every different stroke made a different sound, so the making a different impression upon the flour gave it as many different motions. It appeared also that the powder goes from the place whence the pulse comes; and that in a perpendicular pulse the powder has a kind of vibration; and also, that so long as the sound of the bell lasts the powder seems to be fluid, but as soon as it ceases the powder also becomes still. It was thought that this experiment might contribute to the understanding of the nature of the internal motion in bodies, and Mr. Hooke was "to prosecute it." On April 27 following, the matter was again referred to at the weekly meeting of the Royal Society, and it was moved that the experiment with the glass-bell and powder should go forward. Hooke does not, however, appear to have met these wishes.

The art of television is making progress. Mr. J. L. Baird is endeavouring to transmit images of living faces across the Atlantic, and on April 7 the American Telephone and Telegraph Company gave a successful demonstration of television. The president of the company, Mr. Gifford, who was at New York, had a telephone conversation with Secretary Hoover at Washington. The television apparatus also permitted him to see as well as hear Mr. Hoover. By a special device, also, guests assembled at New York could see the expression of his face as he talked and hear him simultaneously on a loud-speaking telephone. The guests at New York afterwards saw individually by television and talked with the guests at Washington. They also saw the face of a clock shown by a member of the staff at the Bell Telephone Laboratories, Whippany, New Jersey. The experiments prove that under favourable atmospheric conditions it is possible to send images over any distance by television. It is impossible, however, to predict as yet when a cheap and trustworthy system of radio-television will be perfected. An entire scene has to be sent in small individual parts in less than the fifteenth of a second. Only apparatus of extreme sensitivity to light can be used, and the exactness of the synchronisation must not exceed about the hundred-thousandth part of a second. Every one must admire the courage of the inventors who have partially overcome these difficulties.

In the appeal for membership issued by the National Union of Scientific Workers, which was discussed in a leading article in our issue of Mar. 5, it is categorically stated that the strike is not a possible weapon for such a society, and the possibility of its employment has never been considered by its executive. This statement has led Mr. J. Bertram Ward, in a letter to the Editor, to comment on the possible ways in which the force of numbers is to be applied to effect the principal end the society has in view, the improvement of the economic position of professionally qualified scientific practitioners. Will this force be exerted to control the freedom of action of its members? "Is professional dignity to descend to collective bargaining?" Mr. Ward asks, and "is such bargaining ever more effective than education" by means of "reasoned yet vigorously insistent propaganda?" Propaganda in this direction, he continues, "is a method which is irresistible and leaves the individual unrestricted." But the fact cannot be ignored that the salaries being offered to scientific workers, even by the State department responsible for scientific and industrial research, are now reduced to a level which must inevitably react adversely on the quality of new entrants to the profession of science. The department would probably welcome any action which would enable it to represent to the Treasury the need for making science an attractive career for the best brains of Great Britain. Scientific workers themselves are in the best position to state what constitutes an attractive career, and they could, if they brought the collective force of a united profession to bear upon individual members, make it practically impossible for employing bodies to impose upon qualified and experienced scientific workers salaries and conditions of employment which would not be tolerated by members of any other profession.

In connexion with the Smoke Abatement Act which comes into force on July 1, the paper by J. B. C. Kershaw on the relationship between atmospheric impurity and electricity supply, which is published in *World Power* for April, is of interest. The comparisons made between various towns are naturally only rough approximations, as there are many other factors, for example, the consumption of gas per head, which affect the degree of atmospheric pollution. The results, however, give indications that, as the use of electricity increases, the soot and dust fall per annum diminish in inverse ratio. The official figures show also that the consumption of electricity per head of the population depends very largely on the price charged to the private consumer. There are some notable exceptions to these statements, the explanation of which demands further study. The facts brought out by Mr. Kershaw prove that the data now being collected by the Advisory Committee on Air Pollution will prove of value. Birmingham and London can boast of a degree of atmospheric cleanliness which is satisfactory. The atmospheric pollution in these cities is only double that of a purely residential town like Southport and only one-third that of St. Helens or Burnley.

How rapidly the literature of earthquakes is growing is shown by the issue begun last year of the *Bibliographical Bulletin*, prepared by the Eastern Section of the Seismological Society of America. The *Bulletin* appears quarterly, and the recent issue (for Oct.-Dec. 1926) contains one hundred entries, besides addenda, many of which are accompanied by brief summaries. Copies of papers for notice in future numbers of this useful journal should be sent to the Dominion Observatory, Ottawa, Canada.

The Air Ministry has published the fourth edition of the "Marine Observers' Handbook" (London: H.M.S.O. 3*s*. 6*d*.). The pamphlet has been thoroughly revised and contains, in addition to chapters on the use of instruments, sections on non-instrumental observations, including optical phenomena and hydrographic observations. There are also some useful correction and conversion tables, and a tinted supplement illustrating the chief forms of clouds. Though the publication is mainly intended for marine observers, it would prove of almost equal value at land stations.

The Report of the Bankfield Museum, Halifax, for the year 1925–26, is apparently the first to be published by the committee, which thus signalises the first year of service of Mr. G. R. Carline, who succeeded the late H. Ling Roth on April 1, 1925. Mr. Carline seems to be carrying on the good work with much energy. There were three special exhibitions of art objects during the year. The collection of pottery has been rearranged; the case devoted to native pottery of British Guiana is of particular importance. Room has been made for an extension of exhibits relating to weaving, which is the subject of chief interest to Halifax. Many additions have been made to this series, as well as to the collection of bygones and objects illustrating local history. The provision of an index to the report is a feature to be commended.

The *Proceedings of the Indian Association for the Cultivation of Science* are now issued under the title, *Indian Journal of Physics*. Part 2 of Volume 1 contains the report of the Association for the year 1925, presented by the secretary, Prof. C. V. Raman. The cost for the year was about 40,000 rupees, towards which the Indian Government contributed 10,000 rupees. Considerable additions have been made to the library, the laboratory apparatus, and the workshop, and during the year fifteen research workers from various parts of India carried out investigations in the laboratory on the scattering of light, the acoustics of the violin, the magnetic susceptibilities of gases, and the properties of surface films. More than twenty papers have been published during the year, four in the *Proceedings of the Royal Society of London*, three in the *Philosophical Magazine*, and the remainder in other scientific journals.

Number 75 of the *Miscellaneous Publications* of the Bureau of Standards, Washington, consists of the annual report of the Director, Dr. G. K. Burgess, for the fiscal year ending June 1926. The total expenses were nearly 2 million dollars, of which 516,000 dollars represent salaries, 232,000 dollars tests of structural materials, 174,000 dollars industrial research, 111,000 dollars standardisation of the products of industry, 100,000 dollars investigations of public utility services and conditions, 70,000 dollars equipment, and 54,000 dollars investigations for the Navy and for aviation. Close contact with the industries of the country is maintained by means of advisory committees composed of technical representatives from the industries and by the research associates appointed by the industries to carry out researches at the Bureau. A visiting committee reports once a year to the Secretary of Commerce on the efficiency of the Bureau. Some of the reductions effected on economical grounds in the varieties of articles of the same description produced by manufacturers are remarkable, *e.g.* files and rasps, from 1351 to 496; sheet steel, from 1819 to 263; concrete blocks, tiles, and bricks, from 115 to 24.

An Illustrated Guide to the Singapore Botanic Gardens has just been published. These Gardens are among the finest of tropical botanic gardens, and as the last guide (issued 1889) has been out of print for some years, the new issue has been long overdue and supplies a much-needed desideratum for botanists and general visitors. In recent years alterations of considerable magnitude have been carried out; and while due attention has been paid to scientific considerations in laying out the gardens, the scenic and landscape aspects have not been neglected. Here most species of the Indo-Malayan flora as well as other forms have been brought together and skilfully arranged. Some species are grouped on conventional garden lines, and others are assembled in a kind of natural jungle. In the Guide the vegetation is described section by section of the Garden, with interesting notes on large numbers of the species. The work is profusely illustrated with photographs of the more striking scenes and species, while an index of species and a good map of the Gardens complete the book.

The "Report on the Health of the Army for the Year 1925" (vol. 61) (London: H.M.S.O. 3*s*. 6*d*. net) has recently been issued, fourteen months after its predecessor, and it is hoped that the report for 1926 will be published still more quickly. The report is arranged by Lieut.-General Sir Matthew Fell, Director-General of Army Medical Services, on the same lines as those for the two preceding years. Throughout the year the health of the troops at home and abroad was satisfactory, and the incidence of sickness shows an improvement on that of the preceding year. Malaria accounts for the largest number of admissions to hospital, and tonsillitis comes third on the list. Only 218 cases of enteric fever occurred in the whole army, of which 184 cases were in India. Inflammation of the middle ear (449 cases) again takes first place as a cause of invaliding out of the army.

The danger to man of the bites of certain spiders seems, after many years of uncertainty, now to be established beyond doubt. Following the description of arachnidism as a definite clinical entity by Dr. Bogen of Los Angeles (Nature, Dec. 25, 1926, p. 927), the death of a child from a spider's bite has been reported from Sydney (*Sydney Morning Herald*, Feb. 24, 1927). The spider responsible, produced at the inquest, was identified as *Euctimena tibialis* Rainbow, a rare trap-door or mygalomorph spider. The scientific interest of this lies in the fact that hitherto all the authenticated and most of the suspected cases of poisoning by spiders have been attributed to the genus Latrodectus, of the family Theridiidæ, whereas Euctimena is a member not only of a different family but also of another sub-order of spiders.

Most countries are now undertaking organised research on the causation, prevention, and cure of cancer, and the University of Sydney has issued a pamphlet on its cancer research and treatment organisation (The Australian Medical Publishing Co., Sydney). A fund of £130,000 has been collected from various sources. Three main lines of research have been developed during the last three years: *bio-physical*, for which a special laboratory has been equipped; *bio-chemical*, and *biological and pathological*, which are being pursued in the University and Hospital departments. It is also proposed to establish a radium institute for treatment.

We have received the annual report for the year ended July 31, 1926, of the National Institute for Research in Dairying, which now forms a constituent part of the University of Reading. The Report summarises the work of the various departments, the condition of the farm and farm buildings, the publications issued, and the financial needs of the Institute. As regards the last named, £30,000 is required for adapting the Shinfield Manor estate which has been acquired for the work of the Institute, towards which £20,408 has so far been collected by grants, donations, and subscriptions.

The International Commission on Illumination will hold a short session at Bellagio on Aug. 31–Sept. 3. A plenary session of the Commission should take place in New York this year, but for various reasons it has had to be postponed until 1928. The session at Bellagio is solely one for the executive committee and the various sub-committees appointed by the Commission to study such problems as factory and school lighting, automobile headlights, heterochromatic photometry, definitions and nomenclature, and colorimetry. It is hoped that the meetings of the sub-committees will do much to facilitate their work and lead to a successful meeting next year, besides enabling the countries which have recently joined the Commission to become acquainted with its work. The meeting at Bellagio will be under the presidency of Dr. E. P. Hyde, and the arrangements are being carried out by the Italian National Committee on Illumination.

At the anniversary meeting of the Linnean Society to be held on May 24 next, the following medals will be awarded: The Linnean Medal in gold, given each year to an eminent biologist as an expression of the Society's estimate of his services to science, usually to a botanist and a zoologist in alternation, will be presented to Dr. Otto Stapf. Dr. Stapf has served as Keeper of the Herbarium at Kew, and is now the editor of the *Botanical Magazine*. The Crisp Award was established by a donation of £200 by the late Sir Frank Crisp, for the best paper dealing with microscopical research by a fellow of the Society since the last award, and is made at intervals of five years, accompanied by a medal in bronze and the balance of the income of the principal. The recipient this year will be Prof. Herbert Graham Cannon, professor of zoology in the University of Sheffield, for a paper on the "Post-Embryonic Development of the Fairy Shrimp (*Chirocephalus diaphanus*)," issued last year in the zoological journal of the Society.

The nineteenth meeting of the Australasian Association for the Advancement of Science will be held in Hobart, Tasmania, during the week commencing Jan. 16, 1928. The president-elect is Mr. R. H. Cambage. The following presidents of sections have been elected: Section B (Chemistry), Prof. H. G. Denham, Canterbury College, Christchurch, N.Z.; Section C (Geology and Geography), Prof. L. A. Cotton, University of Sydney; Section D (Zoology), Dr. Colin Mackenzie, Director of the National Museum of Australian Zoology, Melbourne; Section E (History), Mr. T. Dunbabin; Section F (Anthropology), Dr. R. H. Pulleine; Section G (Social and Economic Science and Statistics), Prof. R. C. Mills, University of Sydney; Section H (Engineering and Architecture), Mr. Alan C. Walker; Section I (Medical Science and National Health), Dr. J. H. L. Cumpston; Section J (Education, Psychology, and Philosophy), Mr. M. P. Hansen; Section K (Agriculture and Forestry), Prof. A. J. Perkins, Director of Agriculture, South Australia; Section L (Veterinary Science), Mr. Max Henry; Section M (Botany), Prof. T. G. B. Osborn, University of Adelaide; Section N (Physiology and Experimental Biology), Prof. H. G. Chapman, University of Sydney; Section O (Pharmaceutical Science), Mr. Edward Mayhew. The honorary general secretary of the Australasian Association is Dr. A. B. Walkom, Royal Society's House, 5 Elizabeth Street, Sydney, and the honorary secretary for the Hobart meeting, Mr. Clive Lord, Director of the Tasmanian Museum, Hobart.

A useful and interesting catalogue (No. 284) of second-hand books, and publications of learned societies has just been issued by W. Heffer and Sons, Ltd., 4 Petty Cury, Cambridge. The list comprises upwards of 2000 volumes and is classified as follows: Agriculture, husbandry, and farriery; botany; chemistry, chemical technology, and metallurgy; geology, mineralogy, and palæontology; zoology and biology; anthropology and ethnology; and mathematics, physics, astronomy, and engineering. Included are a number of works from the library of the late Prof. A. Dendy.

In the list of forthcoming books of the Oxford University Press which has just reached us we notice the following:—"Stars and Atoms," Prof. A. S. Eddington. "Conditioned Reflexes of the Cerebral Hemispheres," Prof. I. Pavlov; translated under the supervision of Dr. G. Anrep. "Chemistry," W. H. Barrett. "Animal Biology," Prof. J. S. Huxley and J. B. S. Haldane. "How a Tree Grows," Prof. W. Somerville. "The Flora of Oxfordshire," Dr. George Claridge Druce; second edition. "Oxford Forestry Memoirs." No. 7: "The Gold Coast Forest—A Study in Synecology," Major T. F. Chipp. "Grass Land: Its Management and Improvement," R. G. Stapledon and J. A. Hanley. "The Conquest of the Air," C. L. M. Brown. "A Bird Book for the Pocket," E. Sandars. "Advanced Constructive Geometry," J. F. Dowsett. "Mathematics for Students of Technology": Senior Course, L. B. Benny. "Elements of Mining Science," D. E. Thomas. "A B C of Plastering," A. H. Telling. "Elementary Building Science," A. Everett. "Industrial Electric Motors," W. Wilson. "Essays in Ægean Archæology." Papers presented to Sir Arthur Evans. "The Corridors of Time," H. Peake and Prof. H. J. Fleure. 1. "Apes and Men"; 2. "Hunters and Artists"; 3. "Peasants and Potters"; 4. "Priests and Kings." "Environment and Race": a study of the evolution, migration, settlement, and status of the races of man, Dr. T. Griffith Taylor. "Kingship," A. M. Hocart.

Applications are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in economics in the University of Sheffield—The Registrar (May 12). A university lecturer in mathematics in the University of Cambridge—Prof. A. S. Eddington, the Observatory, Cambridge (May 14). A principal of the Municipal School of Science, Technology, Commerce, etc., Bournemouth—The Director of Education, Town Hall, Bournemouth (May 14). A junior scientific officer on the Air Ministry Scientific Research Staff, for research in connexion with electrical appliances, with special reference to electrical ignition apparatus—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (May 18, quoting A.157). Junior technical officers for the Wireless Experimental department of the Royal Aircraft Establishment—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (May 21, quoting A.160). A lecturer in veterinary pathology bacteriology and protozoology in the University of Sydney—The Agent-General for New South Wales, Australia House, Strand, W.C.2 (June 18). A professor of organic chemistry at the Indian Institute of Science, Bangalore—Dr. M. O. Forster, c/o Messrs. Jeremiah Lyon and Co., 4 Corbet Court, E.C. 3 (June 29). A laboratory assistant, with experience of section cutting and general pathological and bacteriological work, at the Lincoln County Hospital—The Secretary-Superintendent, County Hospital, Lincoln. A graduate in engineering to take mechanical engineering subjects at the Dartford Technical College—The Principal, Technical College, Dartford. Research chemists in the research laboratories of Boots Pure Drug Co., Ltd.—Boots Pure Drug Co., Ltd., Chief Research Chemists, Station Street, Nottingham.

Our Astronomical Column.

Comets.—Four comets are likely to be fairly easy telescopic objects during May. Ephemerides of these, for 0^h U.T., are given below:

		R.A.	N. Decl.	log r.	log Δ.
Comet 1926 *f*, Comas Sola.	Apr. 30.	6^h 48^m 26^s	33° 2′	0·2626	0·3468
	May 8.	7 12 32	32 37	0·2676	0·3602
	16.	7 36 20	31 57	0·2730	0·3741
	24.	7 59 32	31 4	0·2790	0·3874
1927 *c*, Pons-Winnecke.	Apr. 30.	14 57 16	48 13	0·0999	9·6286
	May 8.	15 1 18	50 33	...	9·5704
	16.	15 5 30	52 30	0·0615	9·5041
	24.	15 14 30	53 55	...	9·4206
1927 *d*, Stearns.	Apr. 29.	14 42 20	10 37	0·5683	0·4417
	May 7.	14 34 31	13 18	0·5692	0·4473
	15.	14 26 55	15 42	0·5703	0·4564
	23.	14 19 52	17 47	0·5715	0·4683
1927 *e*, Grigg-Skjellerup.	Apr. 30.	6 46 25	9 16	9·9571	9·6025
	May 4.	6 57 4	12 13	9·9531	9·5650
	8.	7 8 58	15 45	9·9510	9·5248
	12.	7 22 29	20 3	9·9509	9·4822
	16.	7 38 28	25 16	9·9527	9·4385
	20.	7 58 5	31 33	9·9551	9·3957

Popular Astronomy for April contains a photograph of 1927 *d* taken by Prof. G. Van Biesbroeck on Mar. 13. There was a large conspicuous coma, and a faint tail 10′ long in P.A. 215°. The nucleus was of about mag. 11, and was photographed with 20 sec. exposure. This comet has the fourth greatest perihelion distance known, 3·68 units; those exceeding it are 1925 *a*, 4·18 units; 1729, 4·06 units; 1914 III., 3·75 units.

The *Melbourne Age* for Feb. 18 contains the interesting announcement that Mr. Z. A. Merfield proposes to use the great Melbourne reflector for spectroscopic observations of the comet Pons-Winnecke. He is the son of Mr. C. J. Merfield, assistant at Melbourne Observatory, and obtained very successful photographs in Sumatra of the solar eclipse of January 1926. His spectrograph is being mounted on the reflector, which has been out of use for forty years. The comet goes south very rapidly after its perihelion passage on June 21, so it will then be very favourably placed for southern observers.

Prof. G. Van Biesbroeck followed comets 1926 *e* (Giacobini-Zinner), 1925 *a* (Shajn-Comas Sola), 1926 *g* (Neujmin) up to the first week in March; they had been under observation for five months, two years, and four months respectively. He noted that 1926 *g* had been of mag. 12 early in February, but after that it faded rapidly. 1925 *a* had sunk to mag. 16 and it was impossible to follow it for longer.

Research Items.

PRE-SUMERIAN MAN IN ARABIA.—On their return from Kish through the desert lying between Mesopotamia and Palestine in the winter of 1925–26, Mr. L. H. Dudley Buxton and Mr. Henry Field devoted to a search for evidence of the existence of early man in this area such time as was available during the halts of the armoured-car patrol which they accompanied by permission of the Air Marshal. In *Discovery* for April, the former describes the journey and the circumstances in which quite a considerable number of flint implements were found at each stage of the journey. It is interesting to note that the Arab desert police denied the use of flint for any purpose other than strike-a-lights, thus authenticating certain flakes of a somewhat modern appearance. Evidence the most definite in character was obtained at Landing Ground R, a number of implements of Aurignacian type being found. Near Air Force Landing Ground H was found a large lake of perhaps a hundred acres in extent but of not more than a foot deep. On the lower of two surfaces exposed in ancient times, a large number of small tools were found, the other surface showing no evidence of man's handiwork. The implements found on the journey as a whole belong to the middle and late palæolithic age, with one laurel-leaf arrow-head belonging probably to the new stone age. Although the desert conditions are not now such as to support human life, the fact that the implements are found in hollows and little dry valleys suggests that under different climatic conditions, such as probably prevailed in palæolithic times, water flowed down the valley bottoms. This upland divide thus furnishes evidence of man's existence at a period long anterior to that of the material from Mesopotamia itself, where nothing primitive but only the remains of a fairly advanced culture have as yet been found.

SHILLUK BEGGING CUSTOMS.—Among some notes on the customs of the Shilluk, contributed to *Sudan Notes and Records*, vol. 9, No. 1, by the Rev. D. S. Oyler, is an account of begging customs observed especially by women, who seem to derive much pleasure in begging cattle from the richer men of the tribe. The occasion is observed as a holiday for the women of the village, all of whom take part unless there should be too many, when only the women of a certain age go. Women from two villages never unite on these expeditions. The proper time for the begging dances is just before the rains, though they may be held at any time during the dry season. The man from whom the women are to beg is selected before the expedition starts. It is regarded as an honour. As a rule the man selected is not one of their own village, but should he be, the women ask for a sheep only. Although the women usually object to leaving their babies, on these occasions they leave them at home in charge of the men. Before starting a leader is chosen, known as a *bana*, who has the power of a magistrate, is crowned as a village chief is crowned, and deals with any trouble among the women. She acts as chief in any expedition made later by the same party; and in the village she has the right to judge in any dispute strictly between women. In the event of a refusal of an ox, a man's wife may intercede for the visitors, dancing among them; but if the owner persists in his refusal, the party departs cursing him and his family. Any sickness which follows is attributed to this curse, which can only be removed by the return of the party, the gift of an ox, and a petition by the women for the removal of the curse, accompanied by the sprinkling of ashes. A similar custom prevails at the time of threshing corn, when the women sit in silence around the threshing floor holding out their gourds, into which corn is placed when the threshing is finished

THE SPECIES AND SEX-RATIOS OF RAIA.—Augusta Lamont has recorded (*Proc. R. Phys. Soc. Edin.*, **21**, pp. 73-82, 1926) the relative frequency of the species of the genus Raia (the skate) and the sex-ratios of 1714 specimens delivered to the Department of Zoology, University of Edinburgh, for class purposes during the years 1920–1925. These fish were probably for the most part caught in the Firth of Forth or in the neighbouring part of the North Sea. Five species were represented—*Raia radiata* 1069, *R. circularis* 381, *R. batis* 227, *R. clavata* 19, and *R. fullonica* 18. The author points out that to some extent artificial selection, *e.g.* of specimens of convenient size for laboratory work, may have operated to bring about a modification in the relative numbers, so that the proportions are not necessarily indicative of the natural frequency, though they are not markedly at variance with the observations of Day. *R. radiata* was the commonest species from October to May, reaching a maximum in February and March; *R. circularis* was the most frequent species in July but was scarce in the winter and spring. The observations on the sexes cover only four years, and for the five species taken together there were 757 males and 727 females. During the first three years *R. radiata* was represented by 347 males and 310 females, but in the fourth year the respective numbers were 102 and 154, a striking reversal of the previously existing ratio.

THE EGGS AND YOUNG OF HALOBATES.—Dr. H. C. Delsman has had exceptional opportunities for studying this interesting marine insect, the habits and young of which he describes in a recent paper ("On the Propagation of Halobates," *Treubia*, vol. 8, Livr. 3-4, 1926). During his cruises with the investigation-steamer *Brak* over the Java Sea and along the east coast of Sumatra, the eggs and adults were frequently found. The author is emphatic in stating, contrary to the opinion of other observers, that Halobates cannot dive, and that, if forced under water, it dies after making futile swimming movements in attempting to regain the surface. He distinguished five different sorts of eggs, all attached by a glue-like substance to various floating objects such as seaweeds, Spirula and Sepia shells, and birds' feathers; also coal slag, wood, or cork. Sometimes thousands of eggs were found on one object, and this must have been the result of the egg-laying of many individuals, as no more than twenty-five eggs have been found inside one female. Clear figures are given of the embryo in its various stages. Directly the larva hatches it moults, leaving its skin behind attached to the egg membrane, and the young Halobates move to the surface, adopting at once the mode of life of the adult, its form scarcely differing at all from that of the adult. These are valuable notes on the life-history of members of a little-known group.

A TACHINID PARASITE OF THE LARVÆ OF COCONUT MOTHS.—The larvæ of certain moths of the family Zygænidæ are serious enemies of the coconut, and in the *Malayan Agricultural Journal* for Oct. 1926, Mr. B. A. R. Gater contributes some observations on the life-history of the Malaysian coconut moth

(*Artona catoxantha*). It appears that the larvæ of this insect are parasitised by a tachinid fly, *Ptychomyia remota*. The latter beneficial insect, however, suffers from parasites of its own, which militate to a considerable extent against its utility as a natural controlling agent. In a second paper Mr. Gater gives further details concerning the biology of this tachinid. Its liability to the attacks of hyperparasites is further dilated upon; but in spite of their activities the insect is capable of destroying 30 per cent. to 40 per cent. of its host, and in most cases exceeds that figure. Inquiries were received from Fiji with respect to the possibility of importing into those islands parasites of the Artona moth with the object of testing their effects on an allied zygænid *Levuana iridescens*. The latter insect is an important pest of coconut in Fiji, and the need for attempting its control was urgent. After considerable difficulty, some 300 adult examples of the Ptychomyia reached Suva alive, and it was found that they parasitised the Levuana larvæ as readily as those of their Malayan host. The tachinid has proved its value, and is reported as destroying at times up to 90 per cent. of the Levuana larvæ. It is now well established in Fiji, where its greater efficiency is probably due to its freedom from the hyperparasites that are so prevalent in the Malay States.

Genetics of Dormant Maize.—Genetical investigations at the Connecticut Agricultural Experiment Station (Report 49) have shown that the mature and completely developed dormant maize seed is the outcome of a number of processes in which the cumulative action of at least 27 Mendelian factors is essential, and suggest that further work will probably reveal the necessity for several more. Defective seeds may be hereditary or non-hereditary. In the former case the condition frequently arises by mutation in homozygous inbred strains; it is estimated on an average that one plant in every thirty is heterozygous for defective seeds. Fertilisation occurs in these cases, but the development of embryo and endosperm fails or is rudimentary only. Non-hereditary defectives fall into four classes according to the cause of their abnormal condition. *Parthenocarpic* defectives arise from failure of the pollen tube to reach the micropyle, and consequently neither embryo nor endosperm is formed. The age of the silks and pollen, and probably also environmental conditions, influence the production of this type of seed. *Arrested* seeds, however, contain both embryo and endosperm, but owing to competition of physiological dominance of the adjacent normal seeds, their development is retarded. *Germless* seeds result from a single instead of a double fertilisation and lack an embryo, while *miniature* defectives, though normal in form, are reduced in size, due possibly to an abnormal number of chromosomes in the endosperm. Altogether thirteen factors have been found which may cause the formation of defective seeds, and five additional factors which in affecting the endosperm may also prevent normal seed development. On the other hand, nine factors have been found which induce premature germination by inhibiting dormancy and are therefore as fatal to the seed as the retarding factors. Since the hereditary units involved in the short period of the plant's life between fertilisation and the resting stage of the embryo are apparently so complex, knowledge of those concerned with the ontogeny of the entire plant is clearly of a rudimentary nature only.

Palæontology in South Africa.—Last year, for the first time in the history of the Geological Society of South Africa, the presidential chair was occupied by a palæontologist. The anniversary address by Dr. S. H. Haughton was therefore of exceptional interest, since it passed in review the leading facts of present knowledge with regard to animal remains in South Africa, their relation to similar faunas from other regions, and the many problems that still await further discoveries for their solution. Of 186 marine species from the Bokkeveld Beds, 40 are common to South America and 71 are varieties of, or are closely allied to, South American forms. The fauna contains an almost negligible European element, suggesting that it flourished along the shores of the Devonian land area that has been called Falklandia. The South African Permian fauna is found in Russia and Scotland, but is absent from central Europe. The conclusion is reached that there was no passage across the Tethys by the Iberian land-bridge, but that migration occurred by way of Syria to Persia or the Caucasus and thence northwestwards. It is pointed out that much more work is necessary to determine the geographical changes that have taken place since the Cretaceous, and an appeal is made to the universities and museums to stimulate and encourage further interest in the study of palæontology, which hitherto in South Africa has been regarded as little more than a subsidiary adjunct to geology.

Oil Contamination as a Climatic Factor.—Mr. L. A. Ramdas, of the Meteorological Office, Karachi, in a letter to the Editor, makes the novel suggestion that the oil which is now being discharged into the sea in appreciable quantities, especially by the wreck of oil-bearing ships, may have a measurable effect on the total rainfall of the globe. It is well known that oil on a water surface spreads out into a very thin film, and it is natural to expect this film to interfere with the free evaporation of the water, a result which has been confirmed by experiment. A decrease of evaporation from the oceans would result in a general decrease of rainfall over the globe. Mr. Ramdas tested this by comparing the mean annual rainfall at 142 stations for the two periods 1880–1900 and 1900–1920, and he found that the mean of the second period was less than that of the first by about one per cent. over the earth as a whole and four per cent. over the tropics. He recognises that this result is not conclusive, but hopes to obtain further evidence, especially by examining the rainfall of individual years in relation to the number of wrecks of oil-bearing ships.

An Ancient Theodolite.—The theodolite in its simplest form is due to Leonard Digges of University College, Oxford (about 1550), and was first described in 1571 under the name of the 'Topographical Instrument.' An example of this instrument made by Humphrey Cole in 1586, with the improvements of the theodolite of Bleau of a later date, was discovered in St. John's College library and is now in the Lewis Evans collection of scientific instruments. A reprint of Digges' description in his "Pantometria" of 1571 has been published with a short preface by Dr. R. T. Gunther (Old Ashmolean Reprints No. IV. Oxford: 3*s*.). It consists of seven chapters of Longimetra, which with Planimetra and Stereometra formed the three books of "Pantometria." Copies of the original diagrams and plates are given in the reprint.

Mica.—With the growth of electrical and allied industries, the supply of mica has become a matter of great importance. Its perfect cleavage, transparency, and lack of colour when in thin sheets; its flexibility, toughness, and non-conductivity of heat and electricity; its resistance to high temperatures, sudden changes of temperature, and to chemical decomposition, constitute an assemblage of properties possessed by no other single mineral and by no artificial products. The mica of commerce is restricted almost entirely to the varieties *muscovite*, potash mica, and *phlogopite*, magnesian mica. Slight differences in the physical properties of these micas give rise to forms particularly suited for special purposes. Thus the Indian ruby mica is the best for condensers; the hard green Carolina mica is the most satisfactory for use in stove fronts and furnace peep-holes; whilst, on account of its extreme flatness, the brown mica of certain parts of Georgia makes the finest gramophone diaphragms. What is known as 'silver amber,' an altered form of phlogopite, is, on account of its softness, employed between the commutator segments of D.C. motors and dynamos. In a short paper on "Mica and its International Relationships," recently presented to the Institution of Mining and Metallurgy, Mr. G. V. Hobson has condensed an extraordinary amount of information on the production, distribution, and marketing of this mineral, leading up to a consideration of the international aspects of the industry, a subject of vital importance in war and becoming one of scarcely less significance in times of peace.

The Support of Coal Workings.—The sub-committee appointed to investigate methods of reducing the number of accidents due to falls of ground in the coal-mines of Great Britain has issued three reports—Papers Nos. 6, 12, and 30—of which the latter is now before us (Safety in Mines Research Board: The Support of Underground Workings in the East Midland Coalfield, Yorkshire, Derbyshire, excluding South Derbyshire, and Nottinghamshire. London: H.M.S.O.; 2*d*.). The committee is commencing by studying the methods of support used in the different coalfields of Great Britain and pointing out any features which they consider might be more generally adopted with advantage. Perhaps the most important recommendation in the present report is that which refers to the tubular steel prop largely adopted by the Butterley Company, Limited. It consists of a steel tube closed at the top, over which passes a sliding sleeve which can be kept in position by a bolt passing through a slot in the sleeve, whilst the upper part of the sleeve carries a wooden plug. When weight comes on, the wooden plug is crushed in the sleeve, which then slides over the tube, the length of slide which the construction admits of being about 6 inches. The prop can, of course, be used over again by inserting a fresh wooden plug. It is stated that where it is in use only one reportable accident, and that not fatal, due to a fall of roof, has occurred during more than a million man-shifts since the prop was introduced more than eight years ago. It is claimed that this prop keeps the roof in better condition, that it maintains roof height better than wooden props, occupies less space, is more durable, more economical, and easier to withdraw. The report emphasises the need of strict supervision and good discipline, and regrets that relatively little is being done in the matter of safety instruction. Finally, a set of model timbering rules is suggested. The modest price at which this paper is published is intended to bring it within the reach of all, and it is to be hoped that coal miners will take advantage of the information thus placed at their disposal.

Conduction of Electricity through Gases.—Prof. Seeliger's recent article in the *Zeitschrift für Physik* (41, p. 535, 1927) illustrates how little is actually known about what takes place in a discharge-tube. His own intensity rule, for example, that the higher the energy required to excite a given line of the spectrum of the contained gas, the nearer does the region where its brightness is a maximum approach the cathode, still awaits an adequate explanation, in spite of its apparent simplicity. The number of electrons which leave the cathode for each positive ion received is uncertain, as well as the mode of conduction across the cathode dark space, and exactly how this is affected when the cathode is raised in temperature in order to lower the cathode fall of potential. It seems likewise impossible at present to reconcile the sharp cathode boundary of the negative glow formed in most cases, with the apparent continuity of the latter and the cathode dark space in pure inert gases. Prof. Seeliger is specially concerned with the origin of the visible radiation, which may be produced either as a result of the recombination of ions, or in the return to their normal state of neutral molecules excited by electron impact. Some conclusions can be drawn about the relative importance of the two processes in different parts of a tube, but even then difficulties arise from our meagre knowledge both of the relative numbers of free electrons and negatively charged molecules which are present, and of the nature of the radiation which results from recombination. Unfortunately, there is no immediate prospect of solution of most of these problems.

Magnesium-Copper Alloys.—A paper on "Magnesium-Copper Alloys rich in Magnesium" was read by Dr. M. Hansen at the recent meeting of the Institution of Metals. It is shown that magnesium is capable of holding copper in solid solution to the extent of about 0·1 per cent. at room temperature and about 0·4-0·5 per cent. at 485° C. It has not, however, been possible to detect any preceptible age-hardening in alloys quenched from 450° C. on standing at room temperatures. This appears to be due to the fact that, even on quenching, the compound is precipitated as microscopical particles, which coagulate as the rate of cooling becomes slower. This coagulation is accompanied by a slight decrease of hardness and a considerable increase of ductility. Ageing at high temperature results in no perceptible change in hardness.

Coal Carbonisation Retorts.—The Department of Scientific and Industrial Research has issued Fuel Research Technical Paper No. 17 (H.M.S.O., 6*d*. net) on "Low Temperature Carbonisation." It is of the nature of an interim report on the behaviour of vertical retorts erected at H.M. Fuel Research Station, Greenwich. These retorts are based in design on Scottish shale practice and are of grey cast iron, externally heated to 625° C. in a setting of very simple construction. They are 21 ft. high, of width tapering from 7 in. at the top to 11 in. at the bottom, and provided with mechanical extraction gear. The coal dispute of 1926 restricted the supplies and choice of coal, but results are given for tests on nine different samples. Non-caking nuts were the easiest to work, and gave the highest yield of tar and the greatest throughput. Caking coals received a preheating treatment which reduced trouble due to sticking. Fine coal was dealt with by briquetting. The 'E' retorts, which have been most successful, have been in use for the twelve months ending Dec. 27, 1926, for the carbonisation of 1350 tons of coal, and were then still fit for further service. With the collaboration of the Cast Iron Research Association, a new retort of special metal is under construction and will be tested alongside those referred to above.

Water Vapour in the Atmosphere.[1]

THE CONSTITUTION OF FOG AND CLOUD.

THE water in the atmosphere is responsible for practically all the variations which are classed as weather. The way in which it enters the atmosphere, the forms in which it is made visible, and the manner in which precipitation, whereby it leaves the atmosphere, is produced, must always be matters of fundamental importance to meteorology and matters which lend themselves most readily to methods of physical research.

The fact that water drops can be cooled below freezing point without solidifying, and that supercooled water drops can exist in the atmosphere, was demonstrated long ago by physicists like Jamin and by meteorologists like Assman. That, however, is not the end of the story, and Dr. Kohler has made full use of the opportunities which his position as director of the Halde Observatory provided, to investigate the matter further. This observatory is situated in the extreme north of Norway, at a height of about 3000 ft. above sea-level, and it experiences in the course of the year the full range of variation of temperature, wind, and weather. The results of researches made there in 1920–23 are published in a collected form in the memoir under notice.

The problem was attacked in two ways :

(1) By microscopic examination of the deposit from fog (or cloud) below freezing point ;

(2) By an examination of coronæ sometimes round the sun or moon, but more frequently round an artificial source of light placed on the highest point of the Observatory and observed from a distance of about 70 yards.

From microscopic examination it was found that even down to temperatures of $-28°$ C., the drops in fog were spherical drops and not crystalline in form. Crystals which fell through the fog invariably had upon them numerous spherical drops which they had picked up in their passage. Though crystals might form on wires and plates exposed to the fog, they also invariably had spherical drops on them, and if the exposures were short enough, the first deposits were practically invariably drops and not crystals.

The observations of coronæ are divided broadly into three sections :

(1) Observations in fog at a temperature definitely above freezing point.

(2) Observations in fog at a temperature definitely below freezing point.

(3) Observations in clouds the temperature of which was not directly observed.

There are simple relations connecting the angular radii of the different rings of a corona formed by spherical drops, with the radius r of the drops themselves. They are :

$$\sin \theta_1 = \frac{1 \cdot 220\,\lambda}{2r},$$

$$\sin \theta_2 = \frac{2 \cdot 233\,\lambda}{2r},$$

where λ is the wave-length of the light used. If the corona were formed by long thin crystals instead of by spherical drops, the formulæ connecting the thickness b of the crystal with the angular radii of the rings would be different :

namely: $$\sin \theta'_1 = \frac{\lambda}{2b}, \qquad \sin \theta'_2 = \frac{2\lambda}{2b},$$

hence $$\frac{\sin \theta'_1}{\sin \theta'_2} = \frac{1}{2},$$

while $$\frac{\sin \theta_1}{\sin \theta_2} = \frac{1 \cdot 22}{2 \cdot 33}.$$

Measurements of θ_1, θ_2 therefore furnish a criterion for distinguishing between coronæ formed by drops and coronæ formed by crystals.

Dr. Kohler found from his measurements that the coronæ in fog were always caused by drops and not by crystals. One or two measurements appeared to be exceptions to the general rule, but these proved on closer examination to be due to special circumstances, such as rain falling at the time of measurement. Observations of coronæ in clouds of the cumulus, alto-cumulus, and strato-cumulus type showed that these clouds also consisted of drops and not crystals, at least on those occasions when they caused coronæ. Observations of coronæ in cirrus and alto-stratus cloud pointed, however, to a crystalline origin. Apart from the evidence of the relative magnitudes of θ_1, θ_2, it appeared that if the coronæ had been caused by drops, the drops must have been unusually and improbably large, considerably larger than the drops in fog at the level of the Observatory. Coronæ formed by these clouds appear, therefore, to be caused by ice crystals, a deduction supported by the fact that aviators find clouds of the alto-stratus type full of ice crystals, though they do not consist entirely of ice crystals. Some years ago, however, Dr. Simpson, in discussing observations of coronæ in the Antarctic, gave reasons for supposing that ice crystals in the atmosphere could not cause coronæ, and in a later section of his paper, Dr. Kohler runs away from the first and obvious deduction from his measurements and leans to the conclusion that in the alto-stratus and cirro-stratus clouds, the coronæ are caused by drops mixed with crystals. His reasons for rejecting the crystal hypothesis do not appear to be entirely conclusive, and the question whether coronæ are caused in some cases by crystals is still an open one.

Dr. Kohler found drops of different sizes in fogs ; a fog causing coronæ did appear to be constituted for the moment of drops of similar size, but as the diameters of the coronæ changed it was evident that the radii of the drops also changed. When the results of some thousands of measurements were arranged according to the frequency of occurrence of drops of different sizes, the frequency distribution was not, as one might have expected *a priori*, according to the normal curve of errors, but maxima and minima occurred at those values which the radii of the drops would have if drops were made by the combination of two, four, eight, sixteen, etc., primal drops. If m were the mass of the primal drop, then the other drops had masses $2m$, $4m$, $8m$, $16m$, etc. Many years ago, Defant published some observations of the sizes of rain drops which pointed to a similar law, but the sizes of Defant's rain drops were 10-100 times the size of the drops in Dr. Kohler's fogs. It is difficult to see why an original set of drops of uniform size should be produced, but if a layer of such primal drops were formed and these primal drops began to combine by two's, the resulting drops would fall through the atmosphere at a different rate

[1] "Untersuchungen über die Elemente des Nebels und der Wolken." (Stockholm: Hilding Kohler, 1925.)

from the primal drops. These combined drops would therefore have a bigger chance of meeting one another than of meeting a primal drop. There would be a tendency towards a greater production of drops consisting of 4 primal drops than of drops consisting of 3 primal drops, and the process would be extended to the next drops of 8 primal drops and so on. As regards the primal drops, Dr. Kohler found two sets with diameters in the neighbourhood of 7μ and 8μ respectively, but the 7μ group was far and away the most frequent.

From an analysis of the rime deposited at the Halde Observatory from fog or cloud, Dr. Kohler found that the average amount of chlorine present was practically the same as the average amount found in rain water collected at Cirencester by Kinch. The actual amount present in samples of rime collected on different occasions varied very greatly. The average was about 3·5 milligrams per kilogram of rime, and the quantities on different occasions varied from 0·07 milligram to 56 milligrams. From an analysis of the results it was found that the same law existed among the chlorine amounts as among the sizes of the water drops; that is, amounts ½, ¼, ⅙, or 2, 4, 6, 8 times the average amount, 3·5 milligrams per kilogram, were found, but there were practically no intermediate amounts. Dr. Kohler considers that the nuclei of condensation are nuclei of salt carried into the atmosphere from the sea, and that these salt nuclei also follow the law of 2. The weight of the primal salt particle is computed to be $1{\cdot}8879 \times 10^{-22}$ grams. Drops of water in the atmosphere are therefore really salt solutions of greater or less strength. The strength depends upon the water vapour pressure and the temperature of the air. If the vapour pressure falls or the temperature rises, water is evaporated from the drops until the solution becomes strong enough to be in equilibrium with its surroundings and vice versa. As the growth or decrease of drops by such processes is continuous, there ought to be drops of all sizes, which is contrary to the law of distribution of sizes of drops found in the earlier part of the paper.

The paper is full of interest. The observations collected in it are invaluable, and the information about the range of sizes of drops from about 4μ to 20μ is most important. Dr. Kohler has endeavoured to apply in statistical sense the criterion which he himself enunciates, that if meteorology is to exist as an exact science, it is necessary to be critical of hypotheses even when they appear to be more or less well founded; but nevertheless one feels that independent testimony—dare one hope, from Scotland—is required of the law of 2, both in the size of drops and in the amount of chlorine present, before it can be included among the established facts of meteorology.

E. GOLD.

The Lunar Eclipses of 1927.

THERE are to be two lunar eclipses in 1927, about the middle and end of the year. Some of their relations to the earth's atmosphere are as follows:

JUNE 15, 1927.—The first eclipse is at its height (mid-eclipse) at 8^h $24{\cdot}2^m$, Universal Time, but the moon barely gets within the umbra on the north side of the earth's shadow. The radius of the geometrical umbra is 40′·8; the outer limb of the moon at mid-eclipse is distant 40′·7 from mid-shadow. At this moment the edge of the shadow nearest to the moon's limb is cast by the earth's surface and atmosphere at about W. 97°·3, N. 63°·75, in the neighbourhood of Baker Lake, which drains into Chesterfield Inlet, on the west shore of Hudson Bay. It would be interesting to know the weather, cloud, and sky conditions in this region at that moment. But the atlas indicates scarcely any population there.

In the eclipse of Nov. 4, 1892, the outer limb of the moon was 43′·0 from mid-shadow, the radius of the geometrical umbra was 45′·4, so that the immersion was deeper than in the coming case. But Gale, at Sydney, N.S.W., reported the limb so bright as to give the impression that the eclipse was not total; Russell, also at Sydney, said definitely that it was not total; Doberck, at Hong Kong, remarked on the brilliancy of the immersed limb. We may expect this time an opportunity to observe the density of the earth's shadow very near to the edge, but due to weather and climatic conditions very different from those which ruled in 1892. Then the grazing-point was over water, between Iceland and Norway, north of the Shetland Islands.

The last rays on the moon's limb at first contact with the umbra graze the earth's surface or atmosphere about W. 174°·7, N. 32°·7. This is at sunset on the open Pacific, north of Pearl and Hermes. The rays at last contact in like manner graze about W. 69°·1, N. 17°·6, a point at sunrise in the Caribbean Sea, considerably south of Catalina Island, south of Santo Domingo. Observations of weather, cloud, and sky at these points are desired, for comparison with direct observations of the shadow edge at these moments.

The two internal contacts at this eclipse come so close together that they are scarcely separable from mid-eclipse. At mid-eclipse the sunrise-sunset line, centred about the sub-solar point at E. 54°·0, N. 23°·3, passes by Cape San Roque, Nova Scotia, Great Slave Lake, New Guinea, Gulf of Carpentaria, and Enderby Land. Of all this great circle, however, only a fraction, perhaps 35°, on the two sides of the Baker Lake region, is effective in illuminating the eclipsed moon.

DEC. 8.—The second lunar eclipse, on Dec. 8, with middle at 17^h $34{\cdot}6^m$, Universal Time, is of much deeper immersion, 11′ or more at most, in the southern half of the shadow. The inner (north) limb of the moon just covers the middle of the shadow. The grazing light at the contacts comes from regions about the points indicated:

First Contact; E. 41°·6, S. 25°·7, in the Mozambique Channel, between Tullear and Europa Island, at sunset.

Second Contact; E. 51°·0, S. 51°·3, in the Sea Tang, south of the Crozets, at sunset.

Third Contact; E. 164°·4, S. 22°·0, south-west of New Caledonia, at sunrise.

Fourth Contact; E. 157°·0, S. 3°·5, north-east of Bougainville Island, at sunrise.

Observations of weather, cloud, and sky at these points are desired, for comparison with observations of the shadow edge at the contacts.

At mid-eclipse the sunrise-sunset line is centred about the subsolar point at W. 85° 75, S. 22°·7, and passes over or near Kaiser Wilhelm Land, Fiji Islands, Sitka, Baffin Land, Cape Farewell, Timbuctoo, Mossamedes, Cape Town. The whole southern half of this great circle is effective in illuminating the eclipsed moon at this moment.

The mere naming of the grazing-points above indicates that observations within a few degrees of them are unlikely to be obtained. Still, it is desired that persons near any such, at sea or ashore, report their observations of weather, cloud, and sky at the sunrise or sunset moments indicated, either to a scientific journal or to the address, Lunar Eclipses, Harvard College Observatory, Cambridge, Mass., U.S.A.

University and Educational Intelligence.

Cambridge.—The Linacre Lecture will be delivered on Friday, May 6, by Dr. J. A. Murray, Director of the Imperial Cancer Research Fund, on the subject of "Multiple New Growths."

London.—Applications are invited (until July 1) for the Laura de Saliceto studentship, of the annual value of £150, for the advancement of cancer research; also (until June 15), for grants from the Thomas Smythe Hughes Fund for assisting medical research. The applications should be addressed to the Academic Registrar of the University, South Kensington.

Glasgow.—At the ceremony of graduation held on Saturday, April 23, the following University prizes, among others, were awarded: The Captain H. S. Ranken, V.C., Memorial Prize to the student who obtained the highest marks in the subject of pathology in the professional examinations held in the year 1926, to Andrew M. Wyllie; Thomson Prize in geography for an essay on "The Economic Geography of the Lanarkshire Coalfield," to David W. Cousin; Bellahouston Gold Medals for eminent merit in theses for M.D. to Dr. George M. Wishart and Dr. Donald M'Intyre; Struthers Gold Medal and Prize for research on "The Development of the Vascular System in the Human Ovum prior to the Establishment of the Heart," to Dr. Donald M'Intyre.

St. Andrews.—The University Court has appointed Dr. George J. Robertson, St. Andrews, to the lectureship in chemistry in the United College, vacant through the resignation of Dr. George MacOwan.

Dr. Peter G. Carter, of the Chemistry Research Laboratory, United College, University of St. Andrews, has been appointed to a lectureship in organic chemistry in the University of Sydney.

It is exactly two years since the Hebrew University of Jerusalem was inaugurated by Lord Balfour, and it is of considerable interest to examine the progress that has been made. An account of this progress is contained in a recent circular sent out by the Board of Governors. The work of the University is at present mainly directed towards research, and the lectures delivered are intended for graduate students. In the Institute of Jewish Studies and in the Arabic section of the School of Oriental Studies, a number of graduate courses are being delivered by twelve professors and lecturers. In the Institute of Chemistry, research workers are being trained, and many papers have been published. A Department of Hygiene has been organised to investigate problems in epidemiology. Important fundamental work has been carried out in the Department of Microbiology. An Institute of Palestine Natural History is being organised. Preparations are in hand for a Mathematics Department and for the erection of a Physics Department. Great progress has been made with the Library, which now has 140,000 volumes, and many valuable scientific collections have been acquired. The annual budget of the University is at present £35,000, and the academic staff numbers about fifty. Steps are being taken to widen the scope of the University, with special reference to the introduction of more extended teaching, and the consolidation of some of the chief departments and sub-faculties.

Calendar of Discovery and Invention.

May 1, 1843.—On this day was published the "Manual of British Botany," a work in which Charles Cardale Babington critically compared the native flora of Britain with continental plants.

May 1, 1866.—Recognised from the first as the leading meteorological journal of the world, the *Meteorologische Zeitschrift* was started by Julius Hann on May 1, 1866, and he continued to edit it with various colleagues until 1921. Its original name was the *Zeitschrift der Österreichischen Gesellschaft für Meteorologie.*

May 2, 1800.—Constructing a voltaic pile by the aid of the information in Volta's famous letter to Sir Joseph Banks in March 1800, Nicholson and Carlisle, on May 2, 1800, demonstrated that water could be split up into its constituent gases by the passage of a current of electricity. Their pile contained 36 half-crowns and 36 zinc discs.

May 3, 1715.—Down to the eighteenth century, accounts of total solar eclipses are meagre. That of May 3, 1715, was observed, however, by several astronomers in England, and Halley has left an interesting account of it. "I forbear to mention," he says, "the chill and damp which attended the darkness of this eclipse, of which most spectators were sensible and equally judges. Nor shall I trouble you with the concern that appeared in all sorts of animals, birds, beasts, and fishes, upon the extinction of the sun, since ourselves could not behold it without some sense of horror."

May 3, 1865.—While serving as a sergeant in the Garibaldean Wars of 1859, Pacinotti thought out the principle of the ring armature dynamo. He constructed such a machine in 1860, and described his invention on May 3, 1865, in the scientific journal *Il nuovo cimento.* Gramme's re-invention of the ring armature in 1870 was done without any knowledge of the work of Pacinotti.

May 5, 1707.—In his "Memoirs," Whiston says: "Mr. Cotes and I began our first course of philosophical experiments at Cambridge, May 5, 1707. In the performance of which certain hydrostatick and pneumatick lectures were composed: they were in number twenty-four, the one-half by Mr. Cotes and the other half by myself, which lectures were afterwards made use of in the like (enlarged) course which Mr. Hauksbee and I performed many years in London."

May 6, 1845.—On this day Wheatstone and Cooke patented the single needle telegraph instrument which has remained in use for more than eighty years.

May 6, 1886.—One of the most important contributions to the study of dynamo design was the paper on dynamo-electric machinery by John and Edward Hopkinson, read to the Royal Society on May 6, 1886. The first part of the paper was devoted to the construction of a characteristic curve for a machine of given dimensions, and the second part to a description of actual experiments with a dynamo, which were carried out at the Salford Iron Works of Mather and Platt.

May 6, 1896.—Commencing his experiments on planes moving through the air in 1887, Langley showed that relatively little power was required to sustain a given weight if the horizontal velocity reached a certain speed. Putting his ideas into practice, he made a steam-driven model aeroplane weighing about 25 pounds, which on May 6, 1896, at Quantico, Virginia, flew for about 1000 yards.

E. C. S.

Societies and Academies.

London.

British Mycological Society, Mar. 19.—W. R. I. **Cook**: Influence of environment on *Ligniera Junci*. Examination of natural habitats shows that slightly acid water with excess of iron favours growth of the fungus. Laboratory experiments show that light is a more important factor in determining infection, as when exposed to light, roots are not infected and any existing infection disappears.—Miss M. P. **Hall**: Zonation in cultures of *Monilia fructigena*. Cultures show concentric bands of sterile mycelium with bands of conidia, which are controlled by the medium. The initial reaction should be acid unless growth induces acidity, and the concentration should not cause staling. Conidia are produced in light but not in darkness. Zonation can also be produced by temperature variation.—K. R. **Mohendra**: Variation in *Sphæropsis Malorum*. Spores from a single pycnidium of a strain of *S. Malorum* gave two kinds of cultures, black and white. The ratio between the two was not constant, the whites increasing from three to one until the blacks had almost gone. Spores from a single white pycnidium gave white individuals only: spores from single black pycnidium gave mainly black but also a few white. The percentage of white colonies could be increased by repeated culture, but one strain gave only black individuals. White strains show a considerable amount of variation in spore formation.—E. Wyllie **Fenton**: Seed mixtures and incidence of fungal diseases. Plots grazed and mown for hay were sown with different seed mixtures. One of the grazed plots and all the hay plots were yellow with *Uromyces Dactylidis*. Absence of a reasonable amount of clover deprived the grasses of a sufficient supply of nitrogen.—E. H. **Ellis**: Fungi in Japanese carvings. An account of the fungi conventionalised in Japanese netsukes.

Physical Society, Mar. 25.—E. **Mallett**: Acoustical experiments with a mechanical vibrator. Preliminary experiments are described with a mechanical device vibrating a piston at one end of a tube so that a sound wave is emitted at the other. The particle velocities in the sound wave are measured by a Rayleigh disc, and resonance curves are drawn. The energy in the sound wave can be calculated from the results. The experiments are directed towards obtaining a standard source of sound, and the results are encouraging.—E. T. **Paris**: On the stationary-wave method of measuring sound-absorption at normal incidence. The apparatus differs from that used by earlier workers in the use of (1) a small tuned hot-wire microphone for determining relative pressure-amplitudes in the sound-waves; (2) the employment of a steady valve-driven source of sound with arrangements for maintaining the strength at a constant value; (3) the screening of source and experimental pipe from disturbances due to the movements of the observer. The relation between the response of the microphone and the amplitude of the pressure-variation in the sound-wave is eliminated.—J. H. **Awbery** and **Ezer Griffiths**: A ball and tube flowmeter suitable for pressure circuits. This robust form of the Ewing ball and tube flowmeter is suitable for the metering of gases or liquids under pressure, as for example the ammonia in a refrigerating plant. The necessary pressure-tight joints for connecting the conical tube to the circuit are described, and also a device for cutting off the flow should the tube fail.

Optical Society, April 7.—C. V. **Raman**: Huyghens' principle and the phenomena of total reflection. The phenomena of total reflection are considered *de novo* from the viewpoint of the principle of Huyghens, which enables us to evaluate the disturbance appearing in the second medium when light is incident on the boundary between two media and is totally reflected into the first medium. The disturbance takes the form of a superficial wave moving parallel to the boundary and involves an acceleration of the reflected wave with reference to the incident wave, which is zero at critical incidence. The intensity of the superficial wave at critical incidence is greater for the component having the magnetic vector parallel to the surface, but diminishes more rapidly with increasing incidence than for the component having the electric vector parallel to the surface. The phase angle between the two components is an *acute* angle, in agreement with the classical treatment based on the Fresnel formulæ, but in disagreement with the conclusions of Lord Kelvin and Schuster.—H. W. **Lee**: The Hartmann formula for the dispersion of glass. The Hartmann formula is accurate within the limits of the Pulfrich refractometer. Optical glasses can be divided into three well-marked classes by their Hartmann constants, with linear relations between the constants in each class.

Cambridge.

Philosophical Society, Mar. 14.—G. I. **Taylor**: An experiment on the stability of superposed streams of fluid. Experiment to illustrate the stabilising effect of a density distribution similar to that which occurs in the air near the ground on a cold clear night. A stream of water flows over a coloured solution of salt. Instability sets in when the upper stream attains a certain velocity.—C. D. **Ellis** and W. A. **Wooster**: The absolute intensities of the γ-rays of radium-B and radium-C. The measured intensities of the groups in the β-ray spectra of these bodies, due to the internal conversion of the γ-rays in the atom that emits them, are used. The magnitude and rate of variation with frequency of the internal conversion coefficient is determined by considering the total energy and total number of the emitted γ-rays, both of which have been measured. To account for the measurements the internal conversion coefficient must vary approximately as the inverse $2 \cdot 65$th power of the frequency and have a value of $0 \cdot 12$ at a frequency corresponding to $3 \cdot 54 \times 10^5$ volts. This result strengthens the evidence for physical reality of internal conversion. Using this co-efficient the intensities of the γ-rays are obtained directly from the intensities of the β-ray lines. One striking result is the amount of energy concentrated in the high frequencies.—P. M. S. **Blackett**: The limits of classical scattering. The condition given by de Broglie for the validity of geometrical optics is applied to the waves associated with a material particle; in particular to find the limits of classical scattering of α-particles by nuclei.—J. A. **Gaunt**: The stopping power of hydrogen atoms for α-particles according to the new mechanics. The classical theory of the stopping of α-particles agrees well with experiment, when account is taken of the transfer of energy to atoms at a considerable distance from the track. The limitations imposed by the stationary states of the old quantum theory seriously diminish the effect of the less close encounters. The new mechanics avoids this starvation of the more distant atoms. The deflexion of the α-particle is neglected. The excitation and ionisation of atoms at distances from the track, which are large in comparison with atomic dimensions, are calculated approximately by perturbation theory. The transfer of energy is nearly the same as on the classical theory.

Dublin.

Royal Dublin Society, Mar. 22.—**L. B. Smyth**: The index fossil of the Cleistopora zone. New material from Hook Head, Co. Wexford, together with a re-examination of the S.-W. Province specimens, shows that this is not a Cleistopora. It has a compact, fibrous cœnenchyma, and a system of ring canals, and is therefore placed in Vaughania Garwood. M'Coy's *Astreopora antiqua* is considered, and the specific name rejected. The name *Vaughania vetus* is proposed. A portion of its ontogeny is worked out. —**Dorothy Beckett**: The influence of separation and pasteurisation on the size and distribution of fat globules in milk and cream. By direct measurement and counting on photographs at magnifications of 250 and 500 of samples of milk, in which the average diameter of globule was $3\cdot7\mu$, and those larger than 6μ contained 9 per cent. of the fat, it was found that the distribution of the smaller globules was unchanged by the creamery process, but in the final cream 36 per cent. of fat was contained in globules ranging from 6μ to 24μ.—**H. H. Poole**: A convenient method of charging electroscopes. A well-insulated variable air condenser of capacity about $0\cdot001\mu F.$, as used in radio reception, is set to its maximum capacity and charged from a battery or D.C. mains. It is then connected to the gold leaf, and by reducing the capacity the potential is raised to any desired voltage within the limit imposed by internal sparking. Initial voltages of either 80 or 220 were found to work well with the electroscope used, which, having a relatively heavy gold leaf, requires a large charging potential. Lower initial potentials could probably be used with many electroscopes, especially if a 'square law' condenser were used.

Royal Irish Academy, April 11.—**J. L. Synge**: Mathematical investigation of the thrust experienced by a cylinder of any section in a current of inviscid liquid, the motion being periodic and a regular train of vortices being formed. The formula obtained differs from that of Kármán, which only contains the first term. (2) Time measurement in an isotropic space-frame. The transitivity of simultaneity (if A is simultaneous to B and B is simultaneous to C, then A is simultaneous to C) is here proved on the simple assumption that the space-frame is isotropic with respect to light propagation.

Paris.

Academy of Sciences, Mar. 21.—**C. Matignon** and Mlle. **G. Marchal**. The reducing properties of beryllium. The isolation of barium, magnesium, potassium, and aluminium. At a temperature of 1200°-1300° C., *in vacuo*, beryllium gives no appreciable amount of vapour, and this, with its high heat of combustion in oxygen, renders this metal a valuable reducing agent. Details are given of the reduction of baryta to barium, magnesia to magnesium, potash to potassium, and alumina to aluminium. Lime is converted under the same conditions into calcium suboxide.—**Pierre Termier**: The tectonic problem of Vanoise and Mont-Pourri (Savoy Alps).—**André Blondel**: Rotating radiophares. A method for supplementing or replacing lighthouses by radio signal stations.—**Léon Guillet** and **Albert Roux**: The gases contained in brass, aluminium, and its alloys. Brass gives from 0·4 to 0·55 of its volume of gases (carbon dioxide and monoxide, hydrogen and nitrogen). Aluminium gave 0·14 of its volume of gas (carbon dioxide and monoxide and hydrogen).—**Beniamino Segre**: The cubic indicator of the linear projective element of a surface.—**Pierre Humbert**: Differential equations which generalise Lamé's equation.—**Octave Onicescu**: The representation of a function by an ensemble of functions and the integral equations which result.—**W. Margoulis**: New experimental researches on the helices of helicopters.—**P. Dejean**: Hardening by traction, hardening by compression.—**R. Wavre**: The stratification of the planets in surfaces of equal density.—**H. André**: The electrical properties of some metallic compounds. Silver sulphide is capable of absorbing a certain quantity of sulphur at a low temperature. This mixture has an electrical conductivity which diminishes with rise of temperature, and is susceptible of numerous industrial applications. —**Vaulot**: The constants of a passive quadripole.—**Léon** and **Eugène Bloch**: The fluorescence of chlorine and bromine.—**E. Doumer**: The electrolysis of aqueous solutions of pure oxalic acid. A mixture of carbon dioxide and oxygen is evolved at the anode, the proportion varying with the current density.—**H. Colin** and Mlle. **A. Chaudin**: Mutarotation and the alkalinity of the medium. The action of soda and of ammonia on the change in rotation of glucose are parallel down to a concentration of $N/5500$.—**W. Ipatief** and **Orloff**: The hydrogenation of dibenzalacetone and of dibenzylacetone.—**Roger Lyon**, **G. Fron**, and **M. Fournier**: The characterisation of old wood as compared with green wood. Old stored wood has a different composition from new wood of the same species. This difference can be detected by microscopical observation or by measuring the hydrogen ion concentration of the water soluble extract.—**Const. A. Kténas**: Discovery of the lower marine Pliocene in the island of Nikaria (Egean Sea).—**P. Martens**: Vital observation of karyokinesis.—**Henri Coupin**: The influence of calcium on *Penicillium glaucum*. It is inexact to say that calcium is useless to *P. glaucum*, since its presence is necessary to the good formation of the conidia.—**E. Miège**: Sudden appearance of a barley with smooth beard.—**Robert Lami**: The liberation, following traumatism, of fungoid symbiosis of the young plants of Cattleyeæ.—**J. Dumont**: The weight ratios of the reacting bodies in colloidal flocculations.—**D. Bach**: The nitrogen nutrition in the Mucorineæ. The assimilation of ammoniacal salts.—**L. Ambard** and **F. Schmid**: The excitability of the nerve centres as a function of their charge of hydrochloric acid.—**Ch. Achard**, **Léon Binet**, and **A. Leblanc**: Death in a superoxygenated atmosphere. An excess of oxygen over the normal atmospheric proportion causes death in animals. It is concluded that inhalations of pure oxygen used in therapeutics should not be too prolonged.—**Charles Richet**: Observations on the preceding communication. The author's observations made in 1904 confirm the conclusions given in the preceding paper. The composition of the atmosphere is an optimum for living beings and any change in either direction is disadvantageous.—**Raymond-Hamet**: The antagonism of hydrastinine and adrenaline.—**J. Chevalier** and **Ripert**: The pharmacodynamic action and physiological titration of preparations of flowers of pyrethrum.—**E. Grynfeltt** and **H. J. Guibert**: The genesis of the fibroid weft of cicatricial tissue in experimental suppurations of the subcutaneous conjunctive.—**Alfred Maubert**: The influence of thorium-X on laccase. In doses between 1 and 5 micrograms, thorium-X causes an activation of laccase: in quantities of more than 10 micrograms, complete inactivation of the ferment is produced.—**G. Levaditi**: The sterilising action of bismuth in syphilis.—**E. Ducloux** and Mlle. **G. Cordier**: A method of immunisation by slow resorption of virulent antigens.

VIENNA.

Academy of Sciences, Feb. 24.—J. Hertzka: Relations between the fundamental chemical numbers.—D. Balarew: The equilibria between the hydrates of calcium sulphate.—T. Radakovic: The interpolation of functions of several variables.—F. Emich: The observation of 'streaks' (*Schlieren*) in chemical experiments. Toepler showed that the observation of flaws was one of the most sensitive methods in optics. This method is applied to testing with the microscope the purity and identity of small quantities of fluid distillates.—F. Trauth: Geology of the northern Radstädter Tauern and of their foot-hills.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 13, No. 1, January).—George B. Kistiakowsky: The activation of gases by adsorption. Measurements were made in a glass vacuum calorimeter of the heats of adsorption of hydrogen on a copper catalyst, before and after poisoning by oxygen, and of carbon monoxide on the active catalyst. Some of the adsorbed gas appears to be activated by the fields of force surrounding unsaturated surface atoms; oxygen oxidises preferentially the most unsaturated surface atoms.—D. H. Kabakjian: Luminescence due to radioactivity. Three types of such luminescence exist. The first, shown by synthetic zinc sulphide under the action of α-rays after an equilibrium condition is reached, may be due to the destruction and re-formation of active centres in the substance. The second is shown by pure radium or radium bromide; the substance shows luminescence after heating. Certain stable molecular configurations are formed at high temperature and persist on cooling until attacked by an α-particle. The third type, thermo-luminescence, is shown by fluorite crystal. Energy is furnished by α-, β- or γ-rays and set free by molecular agitation in the crystal. The lower the temperature the more energy is absorbed, and heating the crystal afterwards intensifies the luminescence.—J. C. Slater: Radiation and absorption on Schrödinger's theory.—Carl R. Doering: The death rate from diphtheria in Massachusetts for 51 years, 1875–1925. In 1875 the death rate was nearly 200 per 100,000 of population; since then there has been a steady rate of decline of about 5·5 per cent. per annum. Figures for New York show a similar decline. The highest rates of decline (1892–1908) occur when the use of antitoxin and bacteriological diagnosis were spreading, but the figures are only doubtfully significant statistically.—Edward L. Thorndike: A fundamental theorem in modifiability. If a certain situation promotes one of a number of responses, the frequency of the use of one 'connexion' causing a certain response does not increase its strength at the expense of other 'connexions' causing different responses. Facilitation and inhibition among the 'connexions' from a situation cannot be explained by 'a drainage theory' towards the stronger 'connexion.'—N. D. M. Hirsch: A summary of some of the results from an experimental study of the East Kentucky mountaineers.—George H. Shull: Crossing over in the third linkage group of Œnothera. The gene for double flowers (mut. *supplena*) in *Œ. Lamarckiana* is closely linked with that for old-gold colour (mut. *vetaurea*); the crossing-over observed is considered to consist in the exchange of factors between the two chromosomes of the same pair.—G. A. Miller: Groups generated by two operators of order three whose product is of order three.

Official Publications Received.

BRITISH.

Papers and Proceedings of the Royal Society of Tasmania for the Year 1926. Pp. iv+196+11 plates. (Hobart: Tasmanian Museum.) 10s.

Union of South Africa: Department of Agriculture. Science Bulletin No. 52: Cost of Production of Maize; Report on the Investigation for the Season 1923–24. By D. W. McKellar. Pp. 28. 3d. Science Bulletin No. 58: The Manufacture of Loaf and Blended Varieties of Cheese. By Prof. H. B. Davel and D. J. Retief. Pp. 20. 3d. (Pretoria: Government Printing and Stationery Office.)

Aeronautical Research Committee: Reports and Memoranda. No. 1060 (Ae. 243): Flying Positions of Control Surfaces of Bristol Fighter. By Capt. G. T. R. Hill. (A.2.b. Stability, Full Scale Expts., 40.—T. 2265.) Pp. 6+6 plates. 6d. net. No. 1068 (Ae. 250): The Full Scale Determination of the Lateral Resistance Derivatives of a Bristol Fighter Aeroplane. Part ii: The Determination of the Rate of Turn Derivatives. By H. M. Garner. (A.2.b. Stability, Full Scale Expts., 43.—T. 2340.) Pp. 4. 3d. net. (London: H.M. Stationery Office.)

Empire Cotton Growing Corporation. Report on the Characteristics of Several Crops that may be suitable as Rotation Crops with Cotton in East Africa and the Possibilities of Marketing Them in this Country. By H. C. Sampson. Pp. 23. (London: Empire Cotton Growing Corporation.) 1s.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 65, No. 364, April. Pp. 389-468+xxx. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

The Carnegie United Kingdom Trust. Thirteenth Annual Report (for the Year ending 31st December 1926) submitted by the Executive Committee to the Trustees on Friday, 11th March 1927. Pp. ii+110. (Dunfermline.)

The South African Journal of Science. Vol. 23: Being the Report of the Twenty-fourth Annual Meeting of the South African Association for the Advancement of Science, Pretoria, 1926, July 5-10. Pp. xliv+1150. (Johannesburg.) 35s. net.

Board of Education. Vacation Courses in England and Wales, 1927. Pp. 21. (London: H.M. Stationery Office.) 6d. net.

Journal of the Society of Glass Technology. Vol. 11, No. 41, March. Pp. x+11+97+124+xxxii. (Sheffield: The University.) 10s. 6d.

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1926. Pp. iv+496+90+11 plates. (London: H.M. Stationery Office.) 15s. net.

Aeronautical Research Committee: Reports and Memoranda. No. 1057: On the Calculation of Stresses in the Hulls of Rigid Airships. By R. V. Southwell. (R. 38 Memorial Prize Essay, 1926.) Pp. 49. (London: H.M. Stationery Office.) 1s. 9d.

Leeds University: Department of Pathology and Bacteriology. Annual Report, 1926, by Prof. Matthew J. Stewart and Prof. J. W. McLeod. Pp. 12. (Leeds.)

FOREIGN.

Proceedings of the United States National Museum. Vol. 69, Art. 16: A Revision of the Parasitic Wasps of the Subfamily Braconinae occurring in America north of Mexico. By C. F. W. Muesebeck. (No. 2642.) Pp. 73+2 plates. Vol. 70, Art. 13: Contribution to the Anatomy of the Chinese Finless Porpoise, *Neomeris phocaenoides*. By A. Brazier Howell. (No. 2662.) Pp. 43+1 plate. Vol. 70, Art. 16: Foraminifera of the Genus Ehrenbergina and its Species. By Joseph A. Cushman. (No. 2665.) Pp. 8+2 plates. Vol. 70, Art. 20: The Occurrence and Properties of Chlorophoenicite, a new Arsenate from Franklin, New Jersey. By William F. Foshag, Harry M. Berman and Robert B. Gage. (No. 2669.) Pp. 6. Vol. 71, Art. 2: The Beetles of the Family Cleridae collected on the Mulford Biological Exploration of the Amazon Basin 1921–1922. By Edward A. Chapin. (No. 2674.) Pp. 10. (Washington, D.C.: Government Printing Office.)

Publications of the Kapteyn Astronomical Laboratory at Groningen. Edited by Prof. Dr. P. J. van Rhijn. No. 41: The Proper Motion and the Distance of the Praesepe Cluster. By Dr. W. J. Klein Wassink. Pp. 48. (Groningen: Hoitsema Bros.)

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 18, Part 4: The Ticks Parasitic on Cattle and Horses in Hokkaido, Japan. By Kisajiro Ogura and Koji Takada. Pp. 199+206+plates 11-15. (Sapporo.)

Contributions to Embryology. Vol. 18, Nos. 90-97. No. 90: Cultivation of Embryonic Heart Muscle, by Warren H. Lewis; No. 91: Correlation of External Genitalia and Sex-Glands in the Human Embryo, by Karl M. Wilson; No. 92: The "Miller" Ovum—the Youngest Normal Human Embryo thus far Known, by George L. Streeter; No. 93: Detailed Form of the Wolffian Body in Human Embryos of the First Eight Weeks, by Jujiro Shikinami; No. 94: Lens Ectoderm and Optic Vesicles in Allantois Grafts, by Vera Danchakoff; No. 95: Menstrual Records and Vaginal Smears in a Selected Group of Normal Women, by Jessie L. King; No. 96: Transformation of Mononuclear Blood-Cells into Macrophages, Epitheloid Cells and Giant Cells in Hanging-Drop Blood-Cultures from Lower Vertebrates; by Margaret R. Lewis and Warren H. Lewis; No. 97: Origin of Thrombocytes and of the Different Types of Blood-Cells as seen in the Living Chick Blastoderm, by S. Sugiyama. (Publication No. 363.) Pp. iii+147+39 plates. (Washington, D.C.: Carnegie Institution.) 5.75 dollars.

Anatomical Texts of the Earlier Middle Ages. A Study in the Transmission of Culture. By Prof. George W. Corner. With a revised Latin Text of *Anatomia Cophonis* and Translations of Four Texts. (Publication No. 364.) Pp. 112+3 plates. (Washington, D.C.: Carnegie Institution.)

Environment of Tetrapod Life in the late Paleozoic of Regions other than North America. By E. C. Case. (Publication No. 375.) Pp. iii+211. (Washington, D.C.: Carnegie Institution.) 2.50 dollars.

Bulletin of the Geological Institution of the University of Upsala. Founded by Hj. Sjögren. Vol. 20. Pp. 286+6 plates. (Upsala: Almquist & Wiksells Boktryckeri A.-B.)

Department of the Interior: Bureau of Education. Bulletin, 1927, No. 1: Educational Directory, 1927. Pp. iii+139. (Washington, D.C.: Government Printing Office.) 20 cents.

Abisko Naturvetenskapliga Station. Observations météorologiques à Abisko en 1915. Rédigées par Bruno Rolf. Pp. ii+76. (Stockholm: Almquist and Wilksells Boktryckeri A.-B.)

CATALOGUES.

Catalogue of Scientific Books and Publications of Learned Societies; including a Selection from the Library of Prof. Alfred Denny. No. 284. Pp. 82. (Cambridge: W. Heffer and Sons, Ltd.)

Bulletin No. 81: The New "Sunic" Flat Potter-Bucky Diaphragm. Pp. 4. (London: Watson and Sons (Electro-Medical), Ltd.)

Diary of Societies.

SATURDAY, April 30.

British Psychological Society (General Section) (jointly with the Cambridge Psychological Society) (at the Psychological Laboratory, Cambridge), at 2.30.—Prof. A. Michotte: Experiments on Learning to Perform Skilled Movements.—At 4.—Demonstrations: The Study of Long Spells of Repetition of a Skilled Task, Miss K. Pollock; An Experiment in Divided Attention, Miss E. J. Lindgren; Peripheral Visual Perception, M. Solaman; Learning to Perform Movements, Miss Blair and Miss Davis; Experiments on Reading, R. W. Pickford; Real and Illusory Visual Movements, Dr. H. de Silva; Constructive Imagination, Dr. E. Hutchinson; The Visual Effects of Flicker, Dr. Buchanan; Apparatus for the Study of Motor Elements of Skill in Shooting, Dr. Banister; Plateaux in a Learning Curve, Mrs. Drury Smith; Localisation of Sound, P. Vernon.—At 5.45.—Symposium on The Relevance of Visual Images to the Process of Thinking—Prof. T. H. Pear, Dr. F. Aveling, F. C. Bartlett.

North of England Institute of Mining and Mechanical Engineers (at Neville Hall, Newcastle-upon-Tyne), at 3.—W. S. Rider: Feeding and Treatment of Animals below Ground and Stabling.—Paper open for further discussion: The Ventilation of a Pyrites Mine, with special reference to Fire-fighting, Safety, and Rescue Work, R. White.

MONDAY, May 2.

Cambridge Philosophical Society (in the Museums, Cambridge), at 4.30.

Royal Institution of Great Britain, at 5.—Annual Meeting.

Society of Engineers (at Geological Society), at 5.30.—O. Brunler: The Internal Combustion Boiler (Brunler Flame).

Royal Society of Arts, at 8.—J. W. T. Walsh: The Measurement of Light (Cantor Lectures) (2).

Society of Chemical Industry (London Section) (Annual Meeting) (at Chemical Society), at 8.—F. Tattersfield and C. T. Gimingham: Recent Investigations on Contact Insecticides.

TUESDAY, May 3.

Royal College of Physicians of London, at 5.—Dr. C. Gordon Douglas: The Co-ordination of the Respiration and Circulation with Variations in Bodily Activity (Oliver-Sharpey Lectures) (1).

Royal Society of Medicine (Orthopædics Section), at 5.30.—Annual General Meeting.

Institution of Civil Engineers, at 6.—Prof. H. C. H. Carpenter: Some Recent Services of Metallurgy to Engineering (James Forrest Lecture).

London Natural History Society (at Winchester House, E.C.), at 6.—F. Martin Duncan: The Lore of the Bee.

Royal Photographic Society of Great Britain, at 7.—F. J. Hargreaves: Amateur Astronomical Photography.

Röntgen Society (at British Institute of Radiology), at 8.15.

WEDNESDAY, May 4.

Royal Society of Medicine (Tropical Diseases and Parasitology Section), at 5.30.—Annual General Meeting.

Institution of Electrical Engineers (Wireless Section), at 6.—C. F. Elwell: The Holweck Demountable Type Valve.—H. Morris-Airey, G. Shearing, and H. G. Hughes: Silica Valves in Wireless Telegraphy.—W. J. Picken: Cooled-Anode Valves, and Lives of Transmitting Valves.

Society of Public Analysts and other Analytical Chemists (at Chemical Society), at 8.—Dr. W. R. Schoeller and C. Jahn: Investigations into the Analytical Chemistry of Tantalum, Niobium, and their Mineral Associates. VII. The Precipitation of Tungstic Acid by Tannin. VIII. The Separation of Tungsten from Tantalum and Niobium.—S. G. Clarke: The Separation of Vanadium and Tungsten.—J. M. Jones and T. McLachlan: The Determination of Moisture by the Volatile Solvent Method.—F. Wokes and Dr. S. G. Willimott: A Study of Antimony Trichloride as a possible Quantitative Reagent for Vitamin A.

Royal Society of Arts, at 8.—Prof. W. E. Dalby: English Railways (Dr. Mann Lectures) (1).

Entomological Society of London, at 8.

Eugenics Society, at 8.

Folk-Lore Society (at University College), at 8.—Mrs. Murgoci: Vampires in Roumania.

THURSDAY, May 5.

Iron and Steel Institute (Annual Meeting) (at Institution of Civil Engineers), at 10 a.m.—Presentation of Bessemer Gold Medals to A. Wahlberg and Prof. C. Benedicks.—F. W. Harbord: Presidential Address.—J. Seigle: Some Aspects of the Technical and Economic Conditions of the Heavy Metallurgical Industry of the East of France, with Particular Reference to the Utilisation of Gases and Motive Power.—Prof. W. A. Bone, L. Reeve, and H. E. Saunders: An Experimental Inquiry into the Interactions of Gases and Ore in the Blast-Furnace.—At 2.30.—Sir Robert Hadfield: (*a*) The Metal Manganese and its Properties; Also the Production of Ferro-Manganese and its History; (*b*) Low-Carbon Alloys of Iron and Manganese.—Alloys of Iron Research. Part V. Introductory, Dr. W. Rosenhain. Preparation of Pure Chromium, F. Adcock. Part VI. Preparation of Pure Manganese, Marie L. V. Gayler. Part VII. Preparation of High Purity Silicon, N. P. Tucker.—Part VIII. The Constitution of Alloys of Iron and Phosphorus, J. L. Haughton.

Royal College of Physicians of London, at 5.—Dr. C. Gordon Douglas: The Co-ordination of the Respiration and Circulation with Variations in Bodily Activity (Oliver-Sharpey Lectures) (2).

Institution of Electrical Engineers, at 6.—Annual General Meeting.

Chemical Society, at 8.—W. Hanhart and Dr. C. K. Ingold: The Nature of the Alternating Effect in Carbon Chains. Part XVIII. Mechanism of Exhaustive Methylation and its Relation to Anomalous Hydrolysis.—H. Bassett and R. G. Durrant: The Interrelationships of the Sulphur Acids.

FRIDAY, May 6.

Iron and Steel Institute (Annual Meeting) (at Institution of Civil Engineers), at 10 a.m.—E. A. Atkins: The Drawing of Steel Wire and its Relation to Qualities of Steel.—Dr. W. H. Hatfield: Heat-Resisting Steels.—Prof. C. A. Edwards and J. C. Jones: The Influence of Annealing Temperature on the Properties of Mild Steel Sheets.—T. Swinden and G. R. Bolsover: Some Notes on Cold-Rolled Strip Steel.—B. Yaneske: The Manufacture of Steel in India by the Duplex Process.—At 2.30.—Prof. C. Benedicks and H. Löfquist: Theory of the Growth of Cast Iron Repeatedly Heated.—J. H. Andrew and H. A. Dickie: The Ac_1 Range in Special Steels.—J. H. Andrew, M. S. Fisher, and J. M. Robertson: The Properties of Some Nickel-Chromium-Molybdenum Steels.—Prof. K. Honda and K. Takahasi: A Further Investigation of the Indentation Hardness of Metals.—T. Matsushita and K. Nagasawa: The Phenomenon of Temper-Hardening in Steels.—S. Tamura: Notes on Pseudo-Twinning in Ferrite, and on the Solubility of Carbon in Alpha Iron at the A_1 Point.

Royal Society of Arts (Indian Section), at 4.30.—B. C. Allen: Assam.

Royal Astronomical Society (Geophysical Discussion on Latitude Observations), at 5.—Chairman: Prof. A. S. Eddington. Speakers: P. H. Wade, Dr. J. Jackson, and others.

Royal Society of Medicine (Laryngology Section), at 5.—Annual General Meeting.

Royal Photographic Society of Great Britain, at 7.—Pictorial Group Meeting.

Photomicrographic Society (at 4 Fetter Lane, E.C.), at 7.—Annual General Meeting and Members' Evening.

Junior Institution of Engineers, at 7.30—W. A. Sallis: Durham Bursar's Paper.

Geologists' Association (at University College), at 7.30.—L. J. Chubb: The Geological Work of the St. George Expedition to the Pacific Ocean.—H. B. Milner, A. J. Bull, G. S. Sweeting, and F. E. Eames: The Geology of South-East Sussex.

Society of Chemical Industry (Chemical Engineering Group) (Annual General Meeting) (at Imperial College of Technology), at 8.—Dr. W. R. Ormandy: Chemical Fire Extinguishers.

Philological Society (Anniversary Meeting) (at University College), at 8.—Z. Arend-Choiński: The Inter-Verbal Phonetics of Cursor Mundi.

Royal Society of Medicine (Anæsthetics Section), at 8.30.—Annual General Meeting.

Royal Institution of Great Britain, at 9.—Major A. Corbett-Smith: China and the Real Chinese.

SATURDAY, May 7.

Royal Society of Medicine (Otology Section), at 10.30 a.m.—Annual General Meeting.

PUBLIC LECTURES.

SUNDAY, May 1.

Guildhouse (Eccleston Square S.W.), at 3.30.—R. A. Smith: Religion in the Late Stone and Bronze Ages.

MONDAY, May 2.

University College, at 8.30.—Prof. R. W. Chambers: Philology at University College.

TUESDAY, May 3.

University College, at 4.30.—Prof. J. S. B. Stopford: Sensation and the Sensory Pathway. (Succeeding Lectures on May 4 and 6.)

King's College, at 5.—Prof. R. J. S. McDowall: Autonomic Nervous System. (Succeeding Lectures on May 10, 17, and 24.)

Medical Society of London, at 5.15.—Sir Thomas Legge: The Teaching of Industrial Medicine (Chadwick Lecture).

Gresham College, at 6.—W. H. Wagstaff: Geometry. (Succeeding Lectures on May 4, 5, and 6.)

WEDNESDAY, May 4.

Royal College of Science, at 5.—Dr. P. Chalmers Mitchell: Logic and Law in Biology (Huxley Memorial Lecture).

THURSDAY, May 5.

Institute of Pathology and Research, St. Mary's Hospital, at 5.—Prof. C. Prausnitz: Experimental Researches on the Nature of the Bacteriophage.